AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 11, No. 24. WEEKLY. | NEW YORK, JUNE 16, 1888. | $2.50 per Annum. SINGLE COPIES 5 CENTS.

COPYRIGHT 1888, BY AMERICAN MACHINIST PUBLISHING COMPANY.

For Sale Everywhere by Newsdealers.

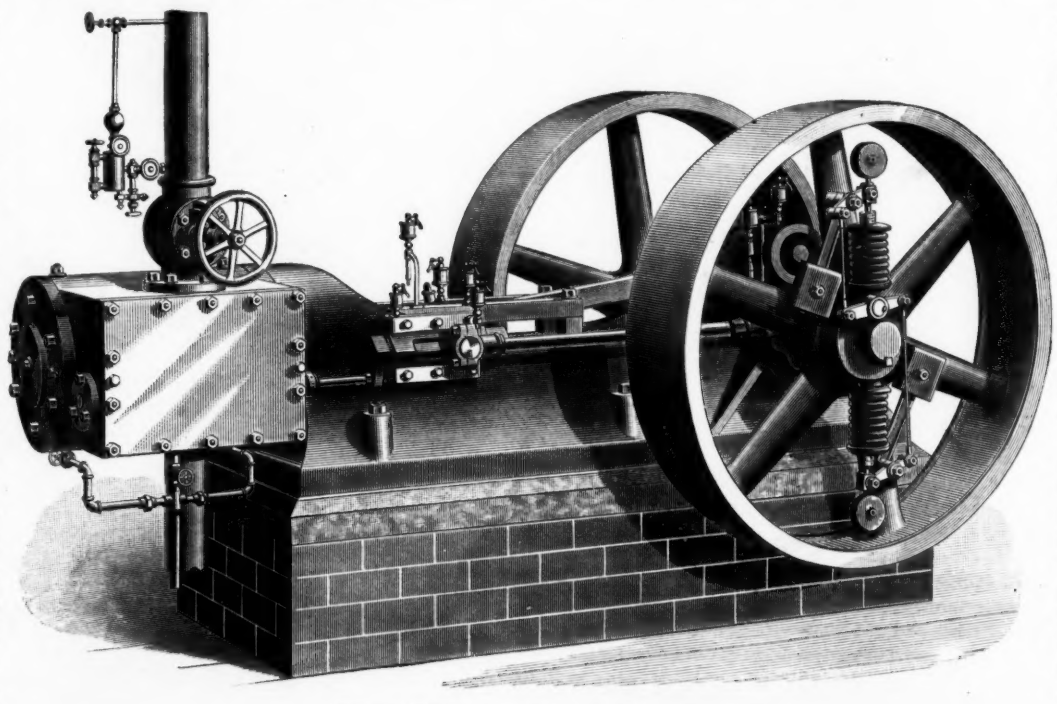
ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

New Automatic Steam Engine.

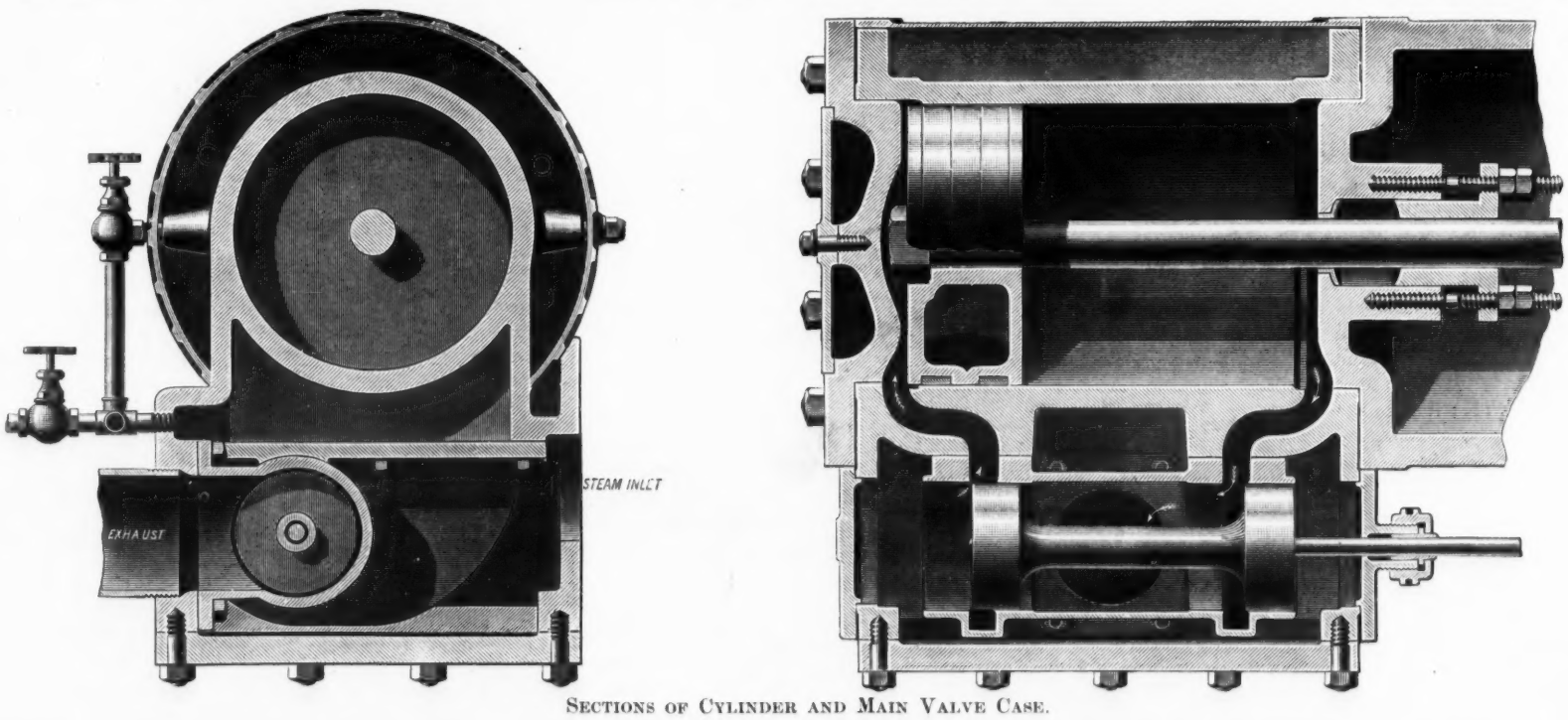
The engine we illustrate on this page and on page 2 is of the single valve type, and possesses some features that will commend it to the attention of those interested in steam engines and in steam engineering. The bed is of the general form quite commonly adopted for engines with overhanging cylinders, and which, from the speed likely to be adopted, require a firm support on the foundation, as well as rigidity. It is a solid, substantial casting, with plenty of metal where required. The forward end of the bed forms one of the cylinder heads, or covers, without the interposition of a loose piece.

A feature of the bed is the arrangement for taking care of the oil escaping from the rubbing surfaces. The bottom interior surface of the bed, below the slides, is inclined towards the crank end, where the shape adopted forms a reservoir of considerable size. Into this reservoir the waste oil from the slides, the crosshead-pin, crank-pin, and from the inside of the main journals readily finds its way. To the outside of the bed, under the main boxes, are cast small pockets, into which the oil escaping from the outside of these boxes drips. From these pockets connections are made with the principal reservoir, previously referred to, by means of small pipes placed in the mould and cast in. Thus provision is made for gathering all the oil drip in the principal reservoir, from which it can be drawn at leisure, by means of a cock provided. This tends to keep the surroundings clean, and provides for saving the oil for future use, with little time and trouble. A depression at the cylinder end of the bed catches the water drip, keeping it separated from the oil. Altogether, the construction of the bed for taking care of the drip is equal to anything we have seen.

The lower halves of the main bearings are cast solid with the bed. In fitting up, the boxes and caps are babbitted, and the babbitt firmly hammered to place. The caps are separated from the lower halves of boxes by babbitt metal liners, and the boxes bored by a special jig attachment, that insures alignment with the cylinder and guides.



FRONT VIEW OF AUTOMATIC ENGINE.



SECTIONS OF CYLINDER AND MAIN VALVE CASE.

The crank-shaft is solid, forged from open-hearth steel. The disks or counterbalances are made fast to the throws of the crank-shaft, as follows: They are cast to pass over the throws, leaving a little space all around except at the "chipping" spots, which, after trimming, will fit the throws. The disks are so made as to permit boring for a short distance to fit a slight enlargement of the shaft next the crank throws, and also to give a true shoulder to come against the crank throw at this point. This bored part centers the disk, and the shoulder keeps it true. The openings in the disk being fitted by means of the "chipping" pieces, to the throw, the space between the disk and throw is filled with melted zinc. Then holes are drilled, half in the throw and half in the disk, and screwed plugs inserted to securely hold the disk in place. This makes a neat, serviceable, solid and counterbalanced crank-shaft.

The connecting-rod is of hammered steel, the ends for the boxes being slotted out, leaving the top open. This is closed by a loose piece, which, when in place, completes the space for the boxes. This piece is locked into the rod end, so that the bolts that hold it in place are not subjected to shearing strain. The adjustment of the connecting-rod boxes is by means of vertical wedges. This form of rod, although but little used, is a good one, if properly constructed, not likely to be disturbed by shock or jar.

The crosshead pin box is of bronze; the crank box is lined with babbitt metal, hammered solid and bored.

The crosshead gets a long substantial bearing on the slides, which are of the locomotive type. The crosshead pin is at the center of the crosshead. This pin is of steel, with square projections at the ends, these projections fitting into slotted recesses in the cheeks of the crosshead. A binding bolt through the cross-head and pin holds it in place, the square projections taking the thrust, relieving the bolt from strain, and preventing the pin from turning.

The valve, as will be seen by referring to detail sectional cuts, is of the piston type. It is fitted in a removable case, provided with the necessary steam passages to the cylinder, and exhaust passage to correspond with the exhaust outlet at the bottom of the steam chest. It will be seen that the case for the valve is surrounded by steam in the steam chest, so as to ensure equal expansion. The exhaust steam is taken directly away from the cylinder, instead of being kept in contact with any part of the outside of it, the part of the cylinder that would otherwise be jacketed with exhaust steam being exposed to live steam in the steam chest. The admission of steam being by the outer edges of the valve, avoids, when first admitting steam, the possibility of expanding the valve before the case, which sometimes causes serious trouble. No packing rings are used in the valve, but it is obvious that, for repairs, for instance, such rings could be employed. Considering, however, the fact that the valve and case can be renewed very quickly, and at little expense, and that the absolute balance of the valve almost literally prevents wear, packing rings are of doubtful economy.

The valve is situated below the center of the cylinder sufficiently to permit the ports to enter the latter at the bottom or lowest points, thus effectually removing the water of condensation during exhaust. The cylin-

der is protected against radiation by an asbestos jacket, covered with metal staves, tastefully finished.

The main piston of the engine is deep, and is packed by the use of two sprung rings, tongued together at the joint. These rings are made so wide that they cannot by any possibility catch in the ports. They are accurately fitted to the sides of the grooves, and are finished to fit the cylinder while sprung to size.

The construction and operation of the governor are quite clearly shown in the cut. It is of simple design, and, as will be seen, is all situated outside the balance wheel, and is hence easily come at for inspection. The governor, by means of the cross-shaft passing through the hub of the fly-wheel outside the main center, operates to shift the eccentric across the shaft, thus varying the throw and the point of cut-off. The governor weights, and, in fact, all its parts, are unusually light. It will be observed that the springs which resist the centrifugal force of the weights do so under compression instead of extension. Friction is reduced by introducing a knife-edge joint at the principal center of motion. The eccentric is counterbalanced, as will be seen by reference to the sectional cut.

In addition to the regular means of lubrication, the main journal caps are provided with covered chambers for tallow or other dense lubricant, that will melt should the oil cups fail to feed. For oiling the crank-pin a hole is drilled through it, longitudinally, other holes being drilled from the periphery of the pin to connect with this hole. An oil cup is mounted on the pillow block caps at each end of the pin. The cups are adjusted to feed regularly, and a metallic "cat's-paw" wipes off the drop of oil and receives it in a pocket, whence it is carried by centrifugal force to the outside of the surface of the pin.

These engines are excellently made, well finished and of neat design. They have been in use a sufficient time to have passed the experimental stage.

They are made by the Phœnix Iron Works, Meadville, Pa.

An Excellent Blue Print.

Mr. W. H. Hoffman brought into our office a large blue print, which, on account of the difficulties encountered in making it, and the excellent results obtained, deserves notice. The tracing from which the blue print was taken is nine feet long and three feet wide; the dimensions of the blue print frame are thirty-six inches by twenty-eight inches. It was, therefore, necessary to fold the paper three times, thereby dividing it into four parts. Each one of these parts, with a portion of the tracing, had to be exposed separately to the light. The junctions of the lines, on these different parts of the blue print, were perfect, the total length of the blue print not differing over a thirty-second of an inch from that of the tracing. The color or shade of the print was the same throughout. Those who have had experience in blue printing will know that it requires great care to obtain every time the same shade or color of blue prints, even when the light is steady; but when the light changes every few seconds from a bright sunlight to partly cloudy, as was the case when this print had to be taken, then to obtain the same color on all the parts of the print exposed at different times, is certainly remarkable. The junctions of the folds were difficult to detect, scarcely showing as much as a slight crease in the tracing would show; in fact, the whole print had an appearance as if it had been made at once in a suitable frame, and an excellent job at that. This blue print was made by Mr. James Scott, employed by Otis Brothers & Co., of Yonkers, N. Y., and illustrates what experience, perseverance, and thoughtfulness will enable a man to do.

Design, Construction, Repairs and Management of Marine Steam Engines and Boilers.

By W. H. Hoffman.

NINTH PAPER.

The upper end of our connecting rod should be as light as conditions will permit. Its form depends on the proportions of the crosshead and pin, so we must fix on the size of the crosshead pin, before we construct, on paper, the yoke end of the connecting rod.

Crosshead pins will run without heating, with from 33 to 50 per cent. more pressure per square inch than a crank-pin.

According to the surface velocities of the two pins, the crosshead pin should stand much more pressure than the figures just given, but an oscillating journal is a bad self-oiler; it will not distribute the oil well, and has a tendency to crowd the oil to one point going forward, and to an opposite point when backing.

Crosshead pins are subjected to pressures varying from 500 to 1,300 pounds per square inch, but I think that 800 pounds should be the limit for stationary engines, and 650 to 700 pounds for marine engines.

Assuming the lattter pressure for our use, we shall have, after allowing for fitting errors, a surface of 142 square inches, and as the crosshead and crank-pins should be the same length, our crosshead pin will be $9\frac{1}{2}''$ in diameter, and 15″ long. Having these figures as our guide, it will be seen that they agree with a rule published by the writer in the American Machinist some years ago, in which the crosshead pin is made $\frac{66}{100}$ the diameter of the crank-pin in all cases. The figures now given leave us a margin of $\frac{1}{2}$ inch in diameter. When a crosshead pin is properly made, it can be kept in a continuous state of lubrication, and it will wear uniformly through its entire oscillating travel; but if otherwise made, it is one of the most troublesome parts of an engine.

The pin must be always flattened on the two sides parallel with the direction of the stroke, the depth of the flat on each side being $\frac{1}{10}$ the diameter of the pin, or, in our case, say $\frac{7}{16}$ of an inch, and this will leave us a net surface of $8\frac{5}{8}\times15$, or 130 square inches absolute.

Although this will in theory raise the pressure per square inch, yet in practice this portion of the pin clipped off is never missed, while the oil pockets made by slabbing the pin, tend materially to prolong the life of the true net wearing surface.

The pin should be held solidly in position, so that the turning action of the upper end of the rod can never affect it in the slightest degree. There should be a broad key on each side, $\frac{1}{4}$ the diameter of the pin in width, and $\frac{1}{8}$ its diameter in depth, outside of the pin. Both keys must be alike, and should be so fitted that the pin can turn half way around if necessary.

The pin being $9\frac{1}{2}''$ in the journal, it will be $9\frac{3}{4}''$ where it passes through one side of the yoke, and $8\frac{1}{2}''$ where it passes through the other side. On the smaller side will be a thread cut $7\frac{1}{2}''$ in diameter, 4 threads per inch, and on this part will be a hexagon nut $11\frac{1}{2}''$ diameter across the flat sides, and $3\frac{1}{4}''$ deep.

As we have now proportioned our crosshead pin, we will fix the form and dimensions of the yoke end of the connecting rod. The end is of the bow or arch form, as it must encircle the lower portion of the crosshead and its cap, bolts, etc. Allowing that our low pressure rod may have an initial pressure of 87,000 pounds, we must have a thickness at each arm of the bow that will resist this load without the slightest tendency to spring in either direction.

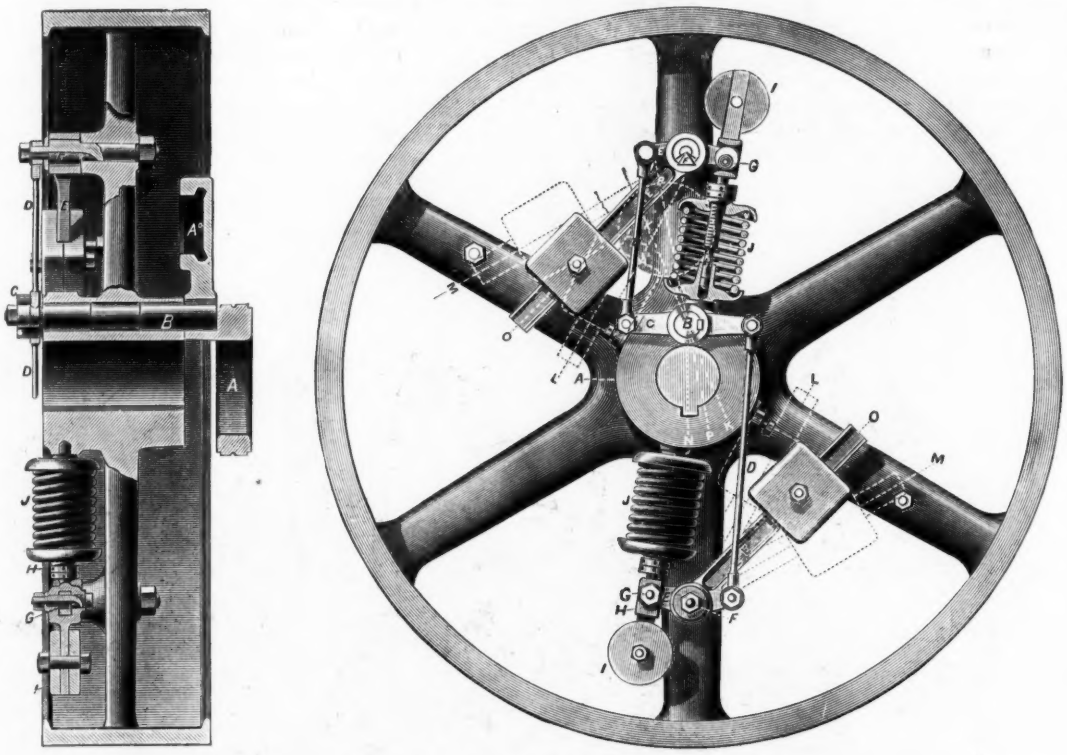
The distance from the center of the pin to the inside or bottom of the yoke will be 24″, and, allowing a $\frac{1}{2}''$ facing hub on the inside of each arm, the width of the yoke will be 16″.

A bar $3\frac{1}{2}''$ thick, $4\frac{3}{4}''$ wide, bent to this form, will resist the load of steady compression without springing, but it is not stiff enough for the concussion of the entering steam, and the shock of the rapid vibrating motion of the rod. This vibration has a tendency to break the rod at the smallest neck, and it sometimes causes a fracture through the side of the yoke, reaching from the crosshead pin hole outward. In order, therefore, to have a rigidity to the arms of the yoke, each one must have a sectional area where it joins the neck of the rod 25 per cent. greater than the neck.

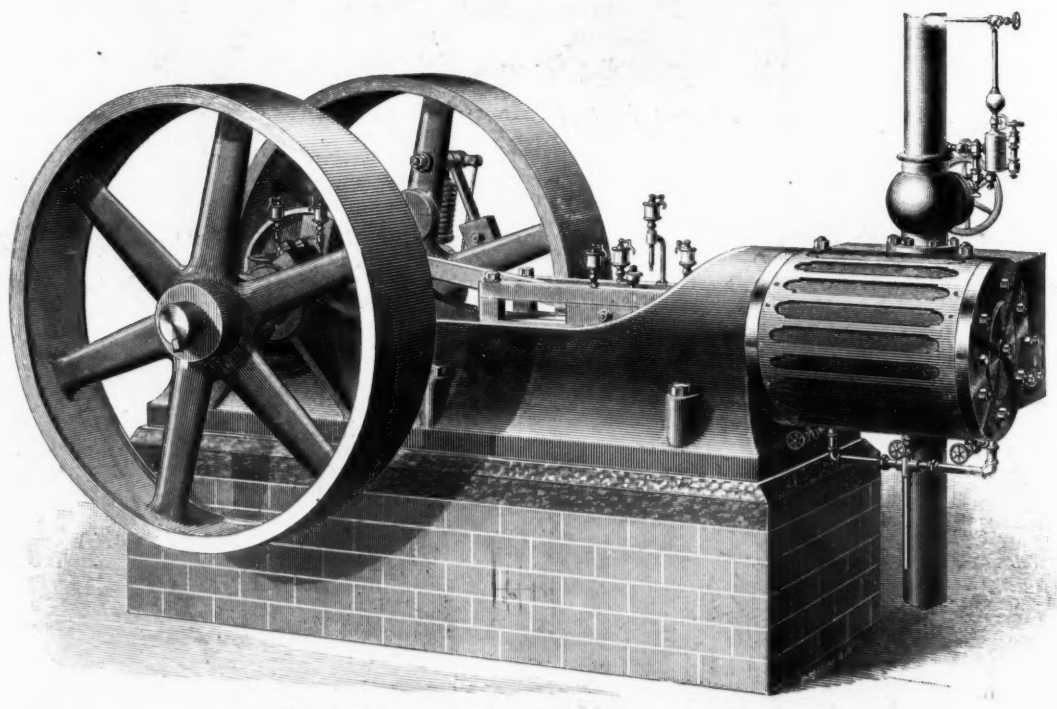
As to the forms of each side arm, the width in the direction of the swing of the rod must be $1\frac{3}{4}$ times its thickness at the eye, and $2\frac{4}{10}$ times at the crown, fore and aft. The addition of the 25 per cent. in sectional area is due to the departure from the true line of force, made necessary by the use of the yoke end. According to our rule we must have a sectional area at the crown of the yoke of 30″, to give us sufficient hold on each end of the crosshead pin; the arm eyes must each be $3\frac{1}{4}''$ thick, and this brings the width at the eye to $6\frac{1}{2}''$, and at the crown of the yoke $8\frac{1}{4}''$. The eyes must have a diameter equal to $1\frac{3}{8}$ times the diameter of the largest crosshead pin hole (which is $9\frac{3}{4}''$), and this will make them 17″ in diameter, and give us a combined sectional area (deducting the key ways) of 76 square inches, showing a large margin of strength.

The crosshead pin boxes will be of phosphor bronze, without any lining. The thickness on the sides at the center of the pin, where they are parted, will be $1\frac{5}{8}''$, and at this point they will be cut away on the circle of the pin to suit the flattened portion of it, always assuring the lap of the box over the edge of pin at the flats to prevent "shouldering." The thickness of each half box, in a vertical direction, will be $2\frac{5}{8}''$, with no water channels, but with a narrow oil dope, top and bottom, and with felt grooves at each end.

These boxes will have flanges, the distance between them being $8\frac{1}{4}''$, which is the thickness of the crosshead portion of the piston-rod, so the projection of the noses of the boxes will be $3\frac{3}{8}''$ on each side. The boxes will be planed in square, with inside corners



DETAILS OF GOVERNOR.—SEE PAGE 1.



NEW AUTOMATIC ENGINE—BACK VIEW.—SEE PAGE 1.

well rounded, and their flanges will be square, but the noses of the boxes will be turned to an end diameter of 14″, and rounded on a radius of 2½, as the flat part of the flange will be 1½″ thick. The flanges will project 1½″ beyond the body of the box all the way around, and the outside corners will be well rounded.

The crosshead pin, will have a hexagon head 11½″ in diameter across the flat sides, and 3″ thick. There will be a hole through the entire length of the pin, 3″ in diameter, reamed to a standard size of arbor, on which the pin will be turned and ground. The pin will be of mild steel, moderately annealed after forging.

I have now described our connecting rod, and its immediate attachments. If these proportions are carried out, the designer will find the rod a little above the average rod in the strength of some details, but he must remember that, for the piston area, we are doing an enormous amount of work. Deducting half the lower stub end, and the distance from the center of the crosshead pin, down to the lower side of the crown of the yoke, the center taper portion of the rod will be 7′ 7″ long; tapered from 5½″ to 7¼″, and from 7¼″ to 6⅝″ at the butt.

Practical Drawing.

BY J. G. A. MEYER.

FIFTY-SECOND PAPER.

PROBLEM 68.

463. *Third Case. To find the intersection of a surface of revolution and a given plane.* —Figs. 348, 349 are respectively the vertical and horizontal projections of a solid, whose dimensions are equal to those of the solid shown in Fig. 343. The line $g_2\ k_2$, in Fig. 349, represents the given cutting plane, and $A\ B$ the ground line. It is required to find the intersection of this plane and the surface of the solid.

In Fig. 349 it will be noticed that the distance $y_2\ a_2$—that is, the distance between the center of the solid and the cutting plane—is greater than the radius $y_2\ h_2$, consequently the given cutting plane does not touch the upper cylindrical surface, and therefore it cannot be tangent to that surface. Under these conditions the curve $g\ a_5\ k$, in which the cutting plane intersects the double curved surface $a_7\ e\ a_9\ e_3$ of our solid, will be somewhat different in form to that of the curve shown in Fig. 343, given in connection with our last problem.

The method for finding the intersection in the problem before us is precisely the same as that adopted for finding the intersection shown in Fig. 343, and explained in Problem 66. Hence nothing more than a brief allusion to the method of finding the curve of intersection $g\ a_5\ k$, shown in Fig. 348, will here be necessary.

Through the center y_2 (Fig. 349) draw the diameter $e_2\ e_6$ parallel to the ground line $A\ B$. From the center y_2, draw a circle tangent to the given plane (or line) $g_2\ k_2$; the circumference of this circle will cut the diameter $e_2\ e_6$ in the points $a_4\ a_8$. Through the point a_8 draw a vertical line cutting the arc $a_9\ e_3$ in the point a_3; through this point draw a horizontal line $a_3\ a$, cutting the line $x\ y$ in the point a_5, and terminating in the arc $a\ e$. The point a_5 will be the highest point in the curve of intersection. Divide the arc $a\ e$ into any number of parts, say four, and through the points of division $b\ c\ d$, draw horizontal lines (lines parallel to the ground line $A\ B$) and terminating in the arc $a_3\ e_3$. These lines $b\ b_3$, $c\ c_3$, $d\ d_3$ will represent intersections of the surface of the solid and auxiliary planes parallel to the horizontal plane of projection. These intersections are represented in Fig. 349 by circumferences of circles. Hence, from the center y_2 (Fig. 349) draw three circles, whose diameters are respectively equal to the lines $b\ b_3$, $c\ c_3$, $d\ d_3$. The circumferences of these circles will cut the line $g_2\ k_2$ in the points b_2, c_2, d_2, on the left-hand side of the center line $e_3\ y$, and the same circumferences will also cut the line $g_2\ k_2$ in the points b_6, c_6, d_6, on the right-hand side of the line $e_3\ y$. Through the points b_2, c_2, d_2, draw vertical lines, the first of these cutting the line $b\ b_3$ in the point b_5; the second, cutting the line $c\ c_3$ in the point c_5; and the last cutting the line $d\ d_3$ in the point d_5. Also, through the point g_2 draw the vertical line cutting $e\ e$ in the point g; the vertical line $g\ i$, terminating in the lines $e\ e_3$ and $f\ f_3$, will be a line of intersection of the lower cylindrical surface and the given plane; and the curve drawn through the points g, d_5, c_5, b_5, a_5, will be the curve of intersection on the left-hand side of the center line $y\ x$.

In a similar manner find the line $k\ l$, and the points $b_7\ c_7\ d_7$ on the other side of $x\ y$; join the points $a_5\ b_7\ c_7\ d_7\ k$ by curved line, and thus complete the intersection of the surface of the solid and the given plane.

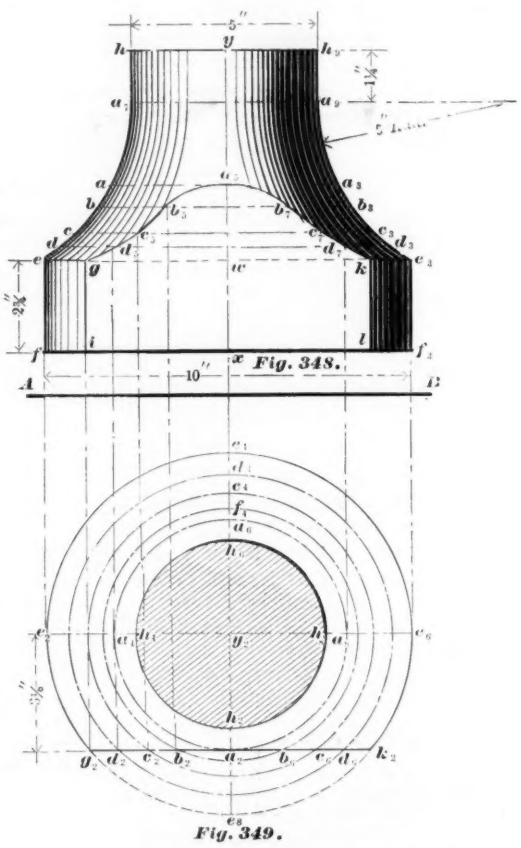


Fig. 348.

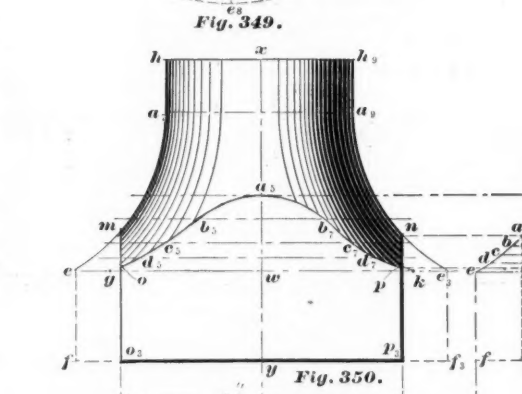


Fig. 349.

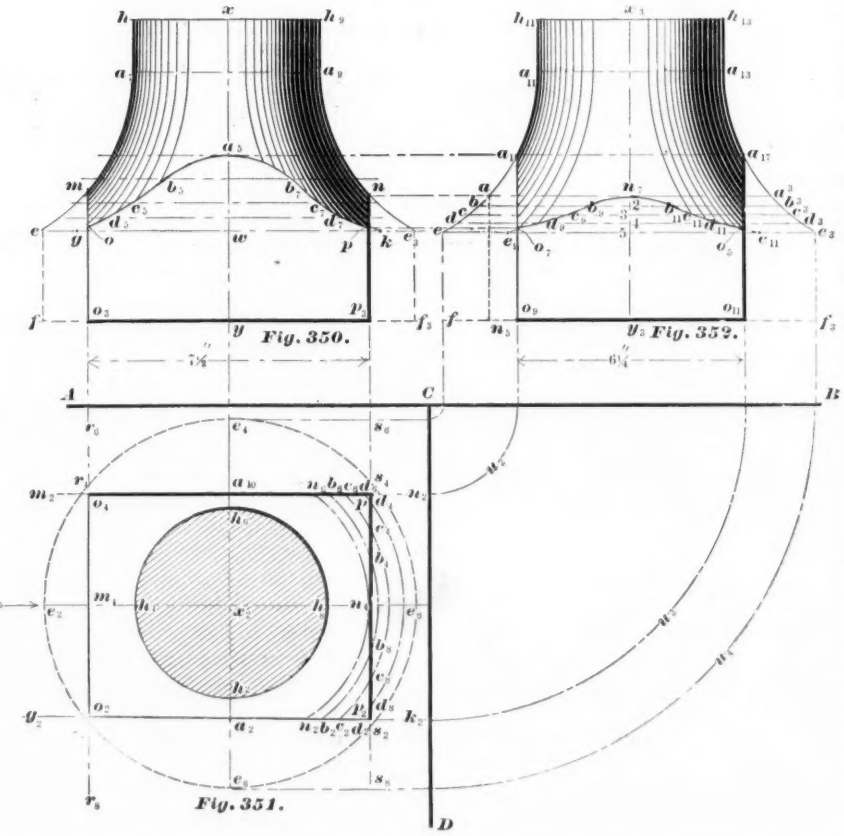


Fig. 350.

Fig. 352.

Fig. 351.

466. We will now go one step further. Let the outline $h\ e\ f\ h_3\ e_3\ f_3$ in Fig. 350 be the vertical, and Fig. 351 the horizontal projection of the same solid which has been shown in Figs. 348,349; and $A\ B$ the ground line as before. Under these conditions the dotted circumference $e_2\ e_4\ e_6\ e_8$, in Fig. 351, and the circumference similarly marked and drawn in full in Fig. 349, will represent one and the same thing, namely, the horizontal projection of the lower cylindrical surface $e\ f\ e_3\ f_3$ (Fig. 350), and the circumference $h_2\ h_4\ h_6\ h_8$ will be the horizontal projection of the upper cylindrical surface $h\ a_7\ h_9\ a_9$. But now, instead of passing one cutting plane only through this solid, as has been done in Fig. 349, we will pass through it four cutting planes, as shown in Fig. 351, and then find the intersections of these planes and the surface of the solid.

Two of these cutting planes are parallel to the vertical plane of projection, and are represented in Fig. 351 by the lines $g_2\ k_2$ and $m_2\ n_2$, drawn parallel to the ground line $A\ B$. The other two cutting planes are perpendicular both to the vertical and horizontal plane of projection, and are represented by the lines $r_6\ r_8$ and $s_6\ s_8$ drawn perpendicular to the ground line $A\ B$. The distances between the center x_2 and the cutting planes $g_2\ k_2$ and $m_2\ n_2$, that is to say, the distances $x_2\ a_2$ and $x_2\ a_{10}$, are equal to each other. Now, because the cutting planes $g_2\ k_2$ and $m_2\ n_2$ are at equal distances from the center x_2, each one will intersect the double curved surface of the solid in a curve, and, under the conditions, these curves of intersection must be exactly alike. Again, because Figs. 350 and 348 represent one and the same solid, and because the distance between the axis x_2 and the cutting plane $g_2\ k_2$ in Fig. 350, is equal to the distance between the axis y_3 and the cutting plane $g_2\ k_2$, in Fig. 348, the curve of intersection $g\ a_5\ k$ in Fig. 350 must be precisely equal to the curve $g\ a_5\ k$ in Fig. 348.

Since we have shown in Figs. 348,349, the method by which this curve is obtained, nothing need to be said in the way of explanation of the manner in which the curve $g\ a_5\ k$ in Fig. 350 can be found.

The distance $x_2\ m_4$ between the center x_2 and the cutting plane $r_6\ r_8$, in Fig. 351, is equal to the distance $x_2\ n_4$, between the center x_2 and the cutting plane $s_6\ s_8$; and therefore the curve in which the plane $r_6\ r_8$ intersects the double curved surface in our solid must be equal to the curve in which the cutting plane $s_6\ s_8$ intersects the same surface; hence, when we have found one of these curves, we will also know the form of the other, because they are exactly alike. But now notice, as soon as we change the distance between the cutting plane and the center x_2 we shall also change the form of the curve of intersection; thus, in decreasing the distance between the cutting plane and the circle $h_2\ h_4\ h_6\ h_8$, the curve of intersection will approach the form of the curve $g\ a_5\ k$, shown in Fig. 343; in increasing the distance between the cutting plane and the circle $h_2\ h_4\ h_6\ h_8$, the form of the curve of intersection will approach a straight line. According to the conditions of our problem, shown in Fig. 351, the cutting planes $r_6\ r_8$ and $s_6\ s_8$ are placed further away from the center x_2 than the cutting planes $g_2\ k_2$ and $m_2\ n_2$, and therefore the curves in which the former planes intersect the double curved surface are not equal to the curves of intersection of the latter planes and the same surface; but the methods of finding these curves are identical.

The full lines in Fig. 352 represent the appearance of the solid, without the portions which have been separated by the cutting planes, when viewed in a direction as indicated by the arrow; the dotted outline represents the portions which have been removed. In this projection we see the curve of intersection made by passing one of the cutting planes, $r_4\ r_8$, $s_4\ s_8$ through the solid. This curve is found in the following manner.

First draw the outline $h\ a_{15}\ e\ f\ h_{13}\ a_{17}\ e_3\ f_3$ of the complete surface of revolution, as shown in Fig. 350. Also, through the center x_2 (Fig. 351) draw the line $e_2\ e_6$, parallel to the ground line $A\ B$, the line $e_2\ e_6$ cutting the line $s_6\ s_8$ in the point n_4. With a radius equal to $x_2\ n_4$, and from y_3 (Fig. 352) as a center, describe a short arc cutting the line $f\ f_3$ in the point n_5; through n_5 draw a vertical line cutting the arc $a_{11}\ e$ in the point a; through this point draw a horizontal line $a\ a_3$, cutting the line $x_3\ y_3$ in the point n_7, and terminating in the opposite arc $a_{17}\ e_3$. The point n_7 will be the highest point in the curve of intersection. Divide the arc $a\ e$ into any number of parts, say four, and through the points of division $b\ c\ d$, draw horizontal lines cutting $x_3\ y_3$ in the points 2, 3, 4, respectively, and terminating in the opposite arc $a_{17}\ e_3$. With a radius equal to 2 b describe from the center x_2 (Fig. 351) an arc $b_2 b_6$, cutting the line $s_6\ s_8$ in the points $b_4\ b_8$; with a radius equal to $n_4\ b_4$, describe from the point 2 as a center short arcs cutting $b\ b_3$ in the point $b_9\ b_{11}$; these points will be two more points in the curve of intersection. With a radius equal to 3 c describe from the center x_2 an arc $c_2\ c_6$, cutting the line $s_6\ s_8$ in the points $c_4\ c_8$; from the point 3 as a center, and with a radius $u_4\ c_4$, describe short arcs cutting the line $c\ c_3$ in the points $c_9\ c_{11}$; these will also be points in the curve of intersection. In a similar manner find the points $d_9\ d_{11}$; and lastly, to find the terminal points of this curve, describe from the point 5 as a center, and with a radius equal to $u_4\ s_4$ (the point s_4 being the point in which the line $s_6\ s_8$ cuts the circumference $e_4\ e_6\ e_8$), two short arcs cutting the line $e\ e_3$ in the points e_9, e_{11}. Join the points $e_9\ d_9\ c_9\ b_9\ u_5$, etc., by a curved line, which will be the required line of intersection. On the line $f\ f_3$ lay off two points o_9 and o_{11}, the distance between y_3 and o_9, also that between the points y_3 and o_1, must be equal to $x_2\ a_2$ in Fig. 351, so that the distance between o_9 and o_{11} will be equal to the distance between the two cutting planes $g_2\ k_2$, $m_2\ n_2$. Through the points o_9, o_{11} draw vertical lines, the former cutting the curve of intersection in the point o_7, and the arc $a_{11}\ e$ in the point a_{15}; the latter vertical line cutting the curve of intersection in the point o_5 and the arc $a_{13}\ e_3$ in the point a_{17}.

Lastly, prolong the lines $r_6\ r_8$ and $s_6\ s_8$ upwards, cutting the base $f\ f_3$ (Fig. 350) in the points o_3, p_3, and also cutting the curve of intersection in the points o, p, and the arcs $a_7\ e$, $a_9\ e_3$ in the points m and n. This will complete the vertical projection in Fig. 350, in which the full lines represent the outline of the solid without those parts which have been separated by the cutting planes.

More of this in our next paper.

The Pond Machine Tool Co.'s Works.

The shops of the Pond Machine Tool Co., recently erected at Plainfield, N. J., are well worth a visit by any one interested in shop architecture, and afford a striking example of what can be done in that line by manufacturers who have had sufficient experience in their particular business, to know just what they require, and at the same time are possessed of the necessary capital to have things just as they want them.

Situated on the outskirts of the city, on the line of the Central R. R. of New Jersey, their location has been chosen not only with a view to convenience of access, and for receiving stock and making shipments of finished products, but also with regard to the healthfulness of the surroundings and consequent welfare of the men who may be employed there.

Light, pure air, and good water are there in abundance, and every provision has been made to make full and liberal use of them.

Coming to the shops from the city, the first building is the machine shop, which is 500 feet long and 100 feet wide, one story high, and abundantly lighted and ventilated from the roof, as well as by windows in the side walls, and heated by overhead system of steam pipes. Through the center of the building runs a track connecting with the railroad, and while there the writer saw a locomotive come in and deliver a car load of stock beside the machine where it was wanted.

The space between this track and one of the rows of posts which support the roof and traveling cranes constitutes the erecting floor, and is provided with a pit 100 feet long, 10 feet wide, and 6½ feet deep, walled up with brick, and having a cement floor. This pit is covered by removable planks, and when heavy machines, especially those which must be worked at from beneath, are to be erected, it is done over this pit, sufficient planks being removed to enable the erectors to get at the work from below.

On the other side of the track, and between it and the other row of posts, the heaviest machine tools are placed.

Above the track, and the spaces each side of it, are two large traveling cranes, each of 15 tons capacity, made by The Morgan Engineering Co. Either of them can travel the entire length of the building, and they are both driven from a 3-in. square shaft, which is in one piece 500 feet long, weighing 7½ tons. It is turned round at the bearings, which touch the shaft on the under side only, and are automatically swung out of the way to allow the cranes to pass, and restored to their places afterwards.

The cranes can be used singly or together, and are controlled by men who are placed in cages provided for the purpose, one on each crane. They work well, but would be greatly improved by the use of cut gears and consequent lessening of noise. It is thus seen that the arrangements for moving heavy work about among the large machine tools, and over the erecting floor, and for finally loading it onto cars for shipment, are very complete, the two cranes commanding a floor space of 500 x 42 feet, within which all the heavy work is done Mr. A. C. Stebbins, the superintendent, says that when moving in the machinery nine cars of it were unloaded in five hours.

Outside of the two rows of posts, and between them and the outer walls, are the smaller machine tools, these spaces being provided with small traveling cranes worked by hand, that over the planers being simply a single rail, upon which travels a hand hoist. In the center of one of these spaces is the tool room, which consists of a bench or cabinet of shelves and cupboards forming a rectangle, accessible on all sides, and surrounded by a wire screen. The usual check system and method of keeping accounts is employed, but no work is done inside, the tools being made elsewhere.

The business offices and superintendent's office are in one corner of the machine shop, and are fitted up with all conveniences for the transaction of business.

In the same end of the building, but in the opposite corner, is the drafting room, which, like the offices, is partitioned off from the machine shop by varnished wood and glass, and within which are to be found all the conveniences necessary for the making and storing of drawings and blue prints, all the appointments and furniture seeming to be particularly well adapted to the uses to which it is to be put. The cabinets in which classified tracings are kept have no drawers in them, but simply trays, upon which the tracings are laid, and which, when drawn out, afford the best possible facilities for examination. Doors, which can be unfastened, raised up on a hinge, and slid back into recesses out of the way, are provided, which give to the cabinet a neat appearance and protect the drawings from dust. All the woodwork is of hard wood, unpainted and varnished. Adjoining the drafting room, and on the outside, is a fire-proof vault, in which duplicates (blue prints) of all drawings are kept, and on top of this vault is a room fitted up with sinks, and all necessary conveniences for making blue prints. It is so situated and lighted as to make available the greatest possible amount of sunlight for printing. Just outside the drawing room, and in the machine shop, is a space set aside for the pattern making.

Adjoining the machine shop is the engine room, in which is a Brown engine of 200 horse-power, and a dynamo for electric lighting (incandescent system), run by a double Armington & Sims engine of 100 horse-power.

Under the engine room is a cellar in which are the steam pumps, one for returning the condensed steam from the heating pipes to the boilers, and the other for fire supply and general service. This pump draws its supply from several large wells, and is regulated automatically by the pressure of water in the pipes throughout the buildings. It is set ordinarily to maintain a pressure of 50 pounds in the pipes, and when that pressure is reached it stops; starting up again when, for any reason, the pressure is reduced, and at a speed commensurate with the reduction. All the water which is used about the works for any purpose is furnished by this pump, so that it is kept almost constantly in action, the drawing of a single pail of water from any one of the numerous plugs causing it to start up. And since there is no reservoir or stand pipe in the system, in which water can accumulate between the pump and the plugs, any failure of the pump to act promptly would be immediately noticed and the trouble remedied. This is undoubtedly far superior to having a pump set apart and used for fires only, because when such a pump is needed it is too apt to be found not quite ready to run, and the buildings are consumed while it is being made ready.

Electric signals are all over the building, communicating with the engine room, and when by this means the engineer receives the fire signal, he goes to this pump, puts an additional weight on the automatic valve which controls it, and the pressure is immediately increased to 100 pounds. At that pressure six streams can be thrown on to a fire in any part of the buildings.

Admirable sanitary arrangements are provided, the water closets being clean, neat, and in no way objectionable, and are provided with abundance of water for flushing.

Not far from the engine room is the wash room, which is well lighted from above only, has a cement floor, and is provided with a number of cast-iron troughs, having overflow pipes. Over the center and above each trough runs a large pipe with numerous branch pipes running out from it, which supplies the water for washing. Steam pipes enter the large pipes by which the water is heated to any desired temperature.

Around the four sides of this room are neat cupboards, one for the use of each man. They are provided with clothing hooks, and can be locked if so desired.

No washing is allowed outside of this room, and it is kept locked by the man in charge until the whistle blows, thus solving a problem which is sometimes rather difficult of solution.

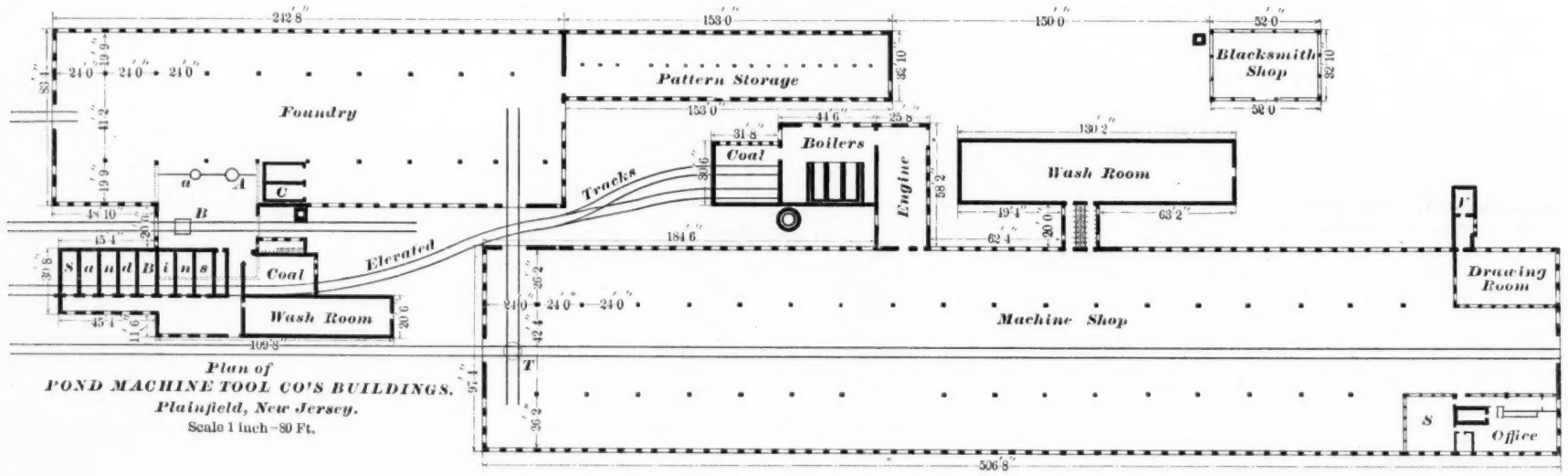
In the south end of the machine shop, in the corner next the foundry, is the stock room, where all supplies are received. The railroad track runs by it, and at right angles to this track another one runs through the stock-room, and on through into the cleaning room of the foundry; the two tracks being connected by a turn-table in front of the stock room. Inside the stock room are track scales on which all castings coming from the foundry are weighed and checked off without being unloaded from the small car on which they are conveyed.

The cleaning room is in the north end of the foundry building, and is provided with a large vat for pickling castings. It is separated from the foundry by a low partition, which allows the large traveling crane to pass over it. This crane is similar to those in the machine shop, and travels the entire length of the foundry. It is used for handling heavy flasks, ladles, etc., and for conveying castings to the cleaning room. Thus, supposing a heavy casting to be made in the southern extremity of the foundry, it would, when cooled, be picked up by this crane, carried north to the cleaning room, and deposited on a car; then, after being cleaned, it would be rolled on this car, through into the stock room, where it would be weighed and the proper entries made, after which it would continue on into the machine shop, where, either by means of the turn-table and tracks, or by the traveling cranes, it would be delivered at any desired spot.

The foundry building, like the machine shop, is well lighted, ventilated and heated, and is supplied with all the latest improved facilities, including a core oven of improved construction. The bottom of the oven is level with the floor of the foundry, and a track runs into it, on which is a truck made entirely of iron. Large cores can be placed on this truck and run into the oven and baked without handling. After which they can be drawn out to a swinging crane, which stands near the oven, by which they can be delivered to the large traveling crane. The core oven is fired at the end opposite the doors, and the heat from the furnace passes through cast-iron flues of flat section, which pass back and forth through the oven at the sides. It is very efficient—a surprisingly small fire serving to keep it amply heated.

There are two cupolas capable of melting 8 and 15 tons of iron per hour, respectively, blast being furnished by a large Root blower. The cupolas are close together, and at one side of the foundry, at a point some distance south of the center, to provide for future extensions in that direction. Back of them is a large clear space, providing for free access, and in this space is a hydraulic lift, on the platform of which are rails which are a continuation of a track which runs out into the yard where the iron is kept.

Back of this space is the sand storage vaults and mixing room. There are ten large vaults made of heavy brick walls, in which are kept the various kinds of sand, clay and other similar supplies used in moulding, and which have a capacity for storing 1,000 tons of sand.



Plan of
POND MACHINE TOOL CO'S BUILDINGS.
Plainfield, New Jersey.
Scale 1 inch = 80 Ft.

building, which is fire-proof, and, like the other buildings, lighted by electricity. A system of shelving, classification and accounting, is made use of, which enables any pattern to be readily found and identified. It is the only building having two floors; the larger patterns being kept on the lower floor, and the smaller ones on shelves above. No shelf is so high as to be out of easy reach from the floor—a point which those who have hunted patterns, with limited knowledge of what they were after, and a step-ladder, will appreciate.

The blacksmith shop is entirely detached from the other buildings—the blast for the forges, and the steam for the steam hammer, being taken to it by pipes. It is 52x32 feet, and the walls, with the exception of door openings, are solid to a point about six feet from the ground, above which they are almost entirely of glass, which is in frames so mounted that they can be swung out at the bottom, and in at the top, upon a pivot fixed at the center. This is effected from the floor by means of levers and the necessary connections to the sash, and they can be fixed and held at any desired angle. It is an exceptionally clean, well lighted and ventilated blacksmith shop. Iron forges are used, and a branch from the blast pipes is taken up into the flue above each forge and turned upwards. The blast in the pipe can be regulated, or turned on or off at pleasure, and helps very much in drawing out smoke and gas, and in keeping things clean.

All the roof timbers and other woodwork about the buildings is dressed, a planer having been set up in the yard and used for the work during their erection.

A special effort seems to have been made in the erection of this plant, to have everything neat, substantial, and of a character best suited to the purpose it is intended to serve, and the result, as it stands, is a decided credit to its designer, Mr. Stebbins, and to its owners.

In the plan view, *a* and *A* are the cupolas, *B* the hydraulic lift, *C* the core ovens, *T* the turn-table, *V* the fire-proof vault for drawings, and *S* the superintendent's office.

Burrell's Improved Liquid Fuel Burner.

In our issue of April 7 we illustrated the above burner, since when it has been considerably improved in its details, sufficient to warrant some further notice.

The burner was first made for the use of the inventor, and without intending to place it upon the market, and was constructed to work satisfactorily under given conditions; but since making it public through our columns it has been sold for such a variety of purposes, and to work under such widely varying conditions, as to character of heat required, quality of oil used, and steam pressure available, that it has been deemed best to so construct it that the supply of air, of steam, or of oil may be regulated at pleasure within the burner itself, to suit varying circumstances.

In the present construction the air openings can be altered to admit any desired volume of air, by turning a small damper, which is also a spring washer, shown in the cut, Fig. 1, at the point marked "air." In Fig. 2 the other view of the damper is shown partly opened. The flow of steam is regulated by turning the outer or steam-regulating cone; in this way the pressure of steam is not reduced before its discharge at the nozzle, and is highly superheated before that discharge takes place. The thread on the central stem has been changed from the stuffing-box near the hand wheel, to a point near the other end, an arrangement which avoids some trouble with the packing, and also enables the stem to be supported and held in a central position at the end, securing an even annular opening and uniform discharge.

This arrangement also makes it possible to remove the central stem for cleaning, or to repack it without shutting off the steam. It will be noticed that with the present construction, every part of the burner which is adjustable is so supported as to insure concentric positions at the discharging end, and thus the annular openings are kept even on all sides. The angle of the discharging cone has also been changed so as to bring the converging point closer to the end of the burner. The oil in getting past the threaded portion of the stem passes through the small channel which is milled through the thread, as shown.

Fig. 2 shows the application of one of these burners to the fire door of a boiler; an arrangement which is used where the boiler is upright, or where the fire-box is surrounded by a water space. It is so arranged that the door can be opened at any time, and in doing so the fittings are so constructed as to shut off the supply of steam and oil. The stop on the door is a simple stud which projects from the door somewhat farther than the burner, so that the burner is prevented from coming in contact with the boiler front when the door is thrown back. The headquarters of D. H. Burrell & Co., for business connected with this burner, is now at Little Falls, N. Y.

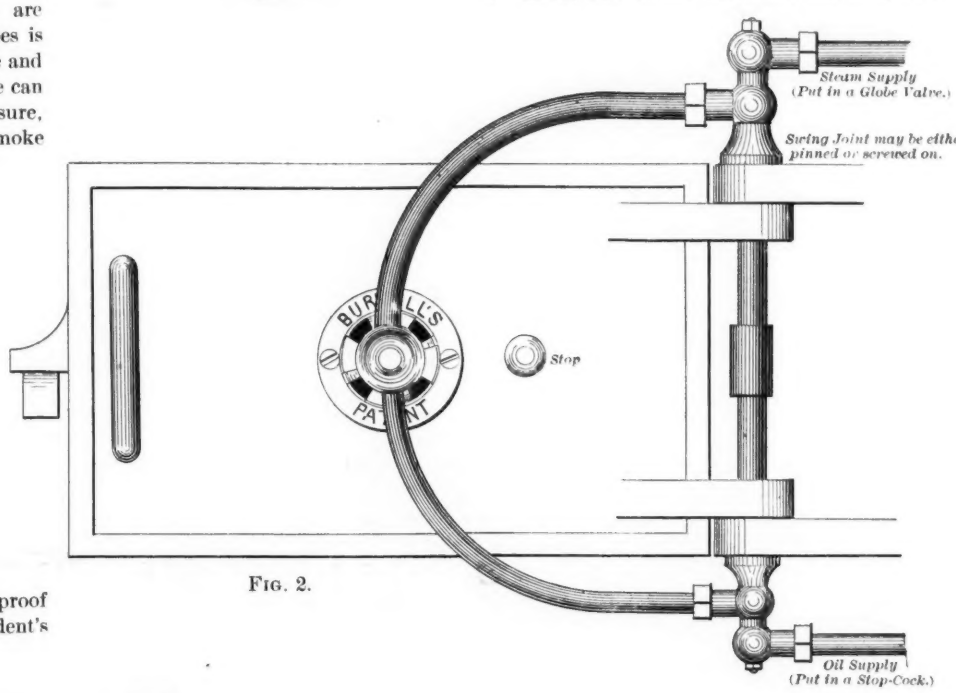


FIG. 2.

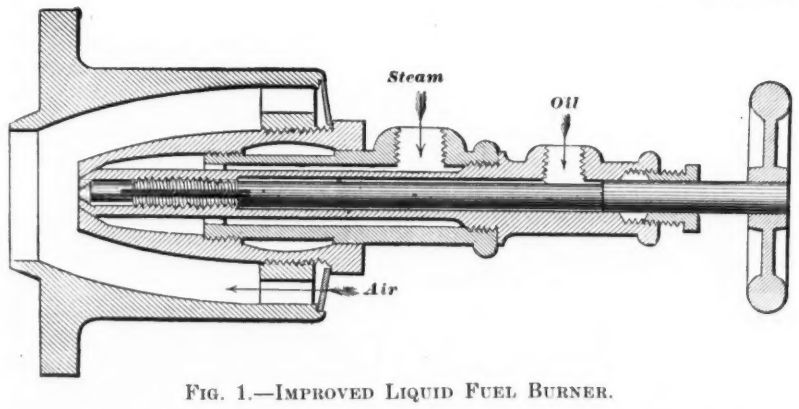


FIG. 1.—IMPROVED LIQUID FUEL BURNER.

LETTERS FROM PRACTICAL MEN.

Speed of Special Tools.

Editor American Machinist:

In reading the article, "Speed of Special Tools," by W. D. Forbes, in your issue of May 26th, I am unable to make out clearly, whether the action of an ordinary, or of an automatic screw machine, is under discussion. I would infer from what is said above the enumeration of movements for making the screw which is shown, that it was an ordinary machine worked by hand, and having a wire feed; while later on, where the changing of pulleys for the shifting devices is spoken of, it would seem as though an automatic machine was meant.

There is considerable difference in the construction and operation of the two, but, so far as my experience goes with screw machines (and I may say that I am somewhat familiar with them), the list, or enumeration of movements, given by Mr. Forbes, might be somewhat misleading to any one not well acquainted with the subject.

Many of the movements mentioned as though taking place successively, one after the other, really take place simultaneously; this statement applying to different movements, however, depending upon whether the machine is a common one or an automatic.

For instance, in the ordinary machine with wire feed the operation, "opening of the chuck jaws" (by which I suppose is meant the opening of the spring collet), the "feed in of the rod," and the "closing of chuck jaws," which by Mr. Forbes are listed as three distinct operations, are, for such a piece of work as is shown, really performed in one operation, which consists in moving a lever from the operator and back again. Then during the "return of turret," the "shift of turret" takes place simultaneously, whether the machine is automatic or not. Thus, six of the movements enumerated should really be taken off, because by themselves they consume no time, and as to the rest of the movements spoken of as not performing actual work, any one who has had much experience in keeping up repairs on the machines worked by hand will agree that they are usually made about as quickly as they ought to be.

In the case of the automatic machine, the cams which produce the various motions can frequently be re-arranged so as to save considerable time, but on the automatic machines with which I am familiar, there are three wheels which carry the cams, one set producing the movements of the turret and slide, another set giving motion to the cut-off and back tools, and the third set feeding the stock and opening and closing the collet.

It is very evident that, since there are three separate sets of cams, they may be so arranged that many of the movements will be performed simultaneously, and, in fact, it is the common practice to so arrange them. For instance, after the completion of a screw, and while it is being cut off and the stock fed through, the turret is being shifted to bring the stop into position, and this is done without consuming any time whatever. So with other operations; the number of such depending upon the character of the work. It will thus be seen that the actual operation of the machine is quite different from the idea which would be gathered from Mr. Forbes' enumeration.

Then as to the speed of the work, I must take issue with Mr. Forbes as to the desirability of changing the speed of a screw machine in making such a screw as his sketch shows. He seems to forget that, though the body and threaded portion of the screw are considerably smaller than the head, yet it is made from stock which is somewhat larger than the head, and that the roughing cuts on the smaller sizes can be taken no faster than those on the head, because the tools are cutting stock of the same size, and the speed at which work can be run is determined by its size before the cut is taken, not the size to which the cut reduces it. In fact, if there is any difference, the cut on the smaller portion should be taken at the slowest speed, because while it is cutting stock of the same diameter it is taking a heavier cut. The smallest part of that screw (the thread) should be made at the slowest speed, if any difference were to be made, because screw machine dies will not stand as high speeds as the other tools; but there should be two dies (a roughing and a finishing die) used, instead of attempting to do it with one die, as Mr. Forbes does.

Now it would seem to any one unfamiliar with screw machine work, that the finishing cut over the body of the screw could be taken at a higher speed than the roughing cuts, because the stock has been considerably reduced in size, and the cut is quite light; but in practice it is not so. The reason is, that considerable variation is allowable in the roughing cuts, and the tools, when dull, are removed, ground, and reset, with comparative ease, while, with the box tool, which takes the finishing cut, the case is different, because this is the tool which reduces the work to gauge, and makes it smooth and workmanlike, if it is to be made so, and on this account a degree of dullness, which, in the roughing tool, would be unnoticed, would be entirely inadmissible in this one, and would spoil the work. Then every time the box tool is ground it must be very carefully adjusted to cut to exact size again, and consequently it is desirable to keep it working as long as possible without grinding. For these reasons, every practical screw machine man understands that a speed which is right for roughing, is plenty fast enough for finishing, notwithstanding that the size has been reduced and the cut is lighter.

Mr. Forbes' ideas seem to be all right by themselves considered, but the trouble is, they do not seem to be founded upon an intimate practical acquaintance with the machines which he is writing about, and it should always be remembered that the AMERICAN MACHINIST is the paper of the practical shop men, and that any lack of practical knowledge of the subject written about on the part of the writer is very quickly detected by them. FAY.

Cylinder Lubrication.

Editor American Machinist:

If there is one subject that the stationary engineer considers himself "par excellence" on, it is cylinder oil. And yet there is not a part of steam engine economy more neglected than this, while there is almost no data to guide one. Perhaps the engine builder may order certain oils and certain amounts, but the next man in charge has to guess at it. There is a vast amount of loose guesswork about the quality of oil, from the crudest notions to others claiming authority. Mainly, though, Jones depends on the color, "can tell everything by that," while Brown goes by smell entirely, while White pours some out, puts in a few drops of water, rubs, and then goes by the sign in the moon. Each has its favorite brand, "best on earth," and the reason he gets along so well with it, is, seven times out of ten, because he floods the cylinder seven times out of ten as often; but I think the boys will agree with me that there is more cylinder oil wasted than used. When employed to run, think it safe to use double

quantity. It is safe as long as the office don't know or don't want to know.

There ought to be some figures on the cost of lubrication, so that one could have them as a base, to compare by, and in absence of better data from better men, I make a few suggestions.

Take an engine, say (because the most common) 12″ x 24″, slide valve, throttle governor, speed 100, B. P. 80, piston rings, steam set out, fair condition.

Exclude, in this calculation the quality of the steam as affected by compounds used in the boiler. Now it would follow, if we knew exactly how much oil this engine would require per hour, that we would have some base to work on for another engine. How shall we know except through the engineer himself? Right here, I think, is where the skill and love of the profession comes in, and, as the runner cuts down the amount fed, he tries by every possible way to see that he is on the safe side. By frequent examination of the cylinder, by the use of the indicator, and by every way known to him, reaching at last, that point where further economy ceases. He has then a standard to compare other oils by. This is the only way known to me to solve this question, and with such an engine I have found the lowest economical cost of oil to be three cents for 12 hours run. Perhaps a better runner could have beaten me safely, but how many do it? T. T. Parker.

Mushet Steel.

Editor American Machinist:

I notice in your "questions" this last week an inquiry by a correspondent as to the manufacture and properties of Mushet steel, which inquiry I will, with your permission, answer in part.

Mushet steel owes its peculiarities to the presence of the metal tungsten, which is usually obtained from its principal ore, wolframite, and resembles iron in properties physically, though not chemically. The steel in question is said to be made by mixing wolframite with its own weight, or about that proportion, of pitch, and adding this mixture to an ordinary crucible charge of steel, the whole being subsequently melted at a high temperature.

It is claimed that the product is of great value as a tool steel, from the fact that it does not need hardening and wears very slowly, indeed.

The experience of machinists with it has been rather different, I find. I have had a small experience with it myself, and have, in some cases, found it all that was claimed for it. In other cases, results were not so good. Perhaps the working of it was the trouble. At all events, it is a very difficult steel to work, and usually costs a blacksmith some time and patience. A uniform product, which would be like some samples I have handled, would be invaluable.

J. Torrey.

Rope Driving.

Editor American Machinist:

Noting the discussion of the manila rope transmission question in the American Machinist's report of the meeting of the Society of Mechanical Engineers, I would say the R. D. Cole Mfg. Co., of this place, have been using manila rope for transmitting for cotton-ginning purposes for the past twelve years. We prefer making the pulleys not less than three and one-half feet in diameter, of good pine, with end of grain to rope. We have made thousands of these, and have tried all shapes of grooves, and find that 55 degrees gives best results. A small slip of the rope causes much greater wear than loss from the supposed wedging in the sharp groove. We fasten rope with a hook made of good Norway iron, the ends of which are flattened to ¼″ thick and bent around tightly, which, up to ten horse-power is sufficient; over that we put one nail through the hook and clinch it. We soak our ropes in warm tar. The above we have found an excellent and cheap means of transmitting power up to 15 horse-power and under 150 feet. Frank B. Cole.

Newnan, Ga.

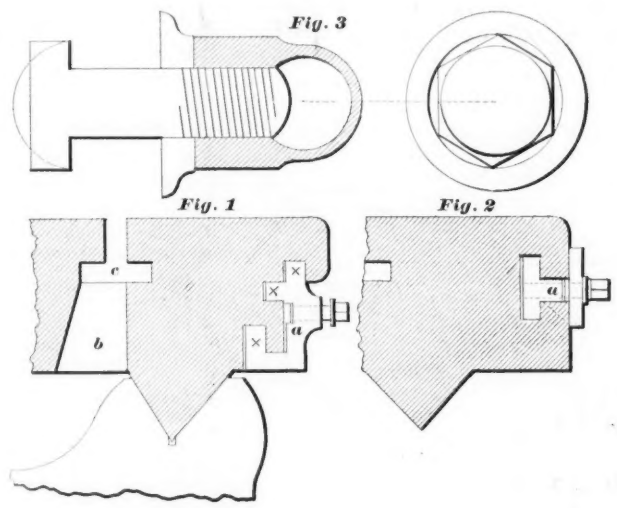
Machine Designing.

Editor American Machinist:

There are some good practical suggestions in Prof. Sweet's recent paper on Machine Designing. If the designer of machinery would consult intelligent operators, whose daily business it is to attend and to repair machinery, and note their various suggestions and criticisms, he would soon find himself in possession of some new ideas which would materially help him in his work of designing.

In my former writing, some suggestions were offered as to the importance of eliminating from machinery all superfluities, ornamentations, "dust catchers," etc. The importance of making all machine plans conform to the solid idea of utility by giving to each detail a careful consideration, and lopping off all useless ledges, corners, etc., everything, in short, which will not help the machine and its operator in their legitimate work. The present sketches are offered simply to illustrate a general principle, which should govern the designer. The first and second sketches show a partial cross-section of a planer table, front edge. The present practice is to fit the dog *a*—which works the belt shifter—to slide in a T channel cut in the edge of the table, as shown in the second sketch. Now, it is proposed to improve this channel slightly by clipping off the corner of the lower lip, as indicated by the dot line, and thus preventing the lodgment of chips and dirt on the lip. A better plan, however, is shown in the first sketch. In this the dog *a* is fitted to slide in three plain square channels *x*, two of the channels being cut vertical, the other horizontal. This brings the dog entirely beneath the table, out of the way of chips, etc.; and square channels are much easier and quicker cut than the T form. Then there should be an outlet *b*, for chips every few inches along the bolt channels *c*, so as to let the chips fall through the table to the floor, and thus relieve the workman of nine-tenths of the trouble of keeping these long channels in condition to receive the bolt heads.

A good form for finished nuts and washers is shown in the third sketch. There is no form more appropriate than the simple curve and the ogee outline. The designs being perfected and patterns made, let fine material, fine workmanship, and fine finish characterize the completed machine. F. G. Woodward.



Machine Designing.

Curious Behavior of a Tap.

Editor American Machinist:

The following bit of experience with a large tap I send you, in hopes it may call out some remarks from some of your clear-headed readers.

The tap referred to is 15″ diameter, 10 threads per inch; has eight cutters, each about ½″ wide, "backed off" the usual way. It has been used horizontally all right, but the "experience" came in when an attempt was made to tap a hole down through a cast-iron plate 1½″ thick. Instead of going through at the rate of 10 turns per inch, it started off and went through at the rate of $\frac{9}{10}$ of an inch to each turn. The thread measured all right, 10 per inch, but was $\frac{9}{10}$ in. pitch. Now, the queer thing about this to me is not that the tap had run in so fast, but that it had started 9 threads when there were only 8 cutters, and still have the threads measure 10 per inch. Will somebody explain? There was a brass ring to be screwed into the hole, and we got out of the scrape by threading the ring to correspond with threads in the hole, and finished the job up in good shape. J. P. L.

Circulation in Steam Boilers.

Editor American Machinist:

In a recent issue I noticed a question as to the economy of heating feed-water, either with pipes in the furnace or water grates.

While the greatest economy can be obtained by waste heat from exhaust steam, or flue gas, yet it is possible that benefit may be derived from heating feed as above mentioned, or with an injector, when waste heat was not sufficient or available.

Pipes in a furnace, as well as water grates, are objectionable, from their liability of bursting at inconvenient times.

One essential point for economy in making steam is that there shall be free circulation without interruption. The admission of cold water seriously interrupts the circulation, even though it be admitted no faster than is taken out by evaporation. The hotter the feed the less will be the interruption, and the greater will be its economy, simply from its mechanical effect. Just what the saving would be could only be determined by experiment, and it would vary as conditions varied.

It would not pay to put up heaters, or a system of pipes, where the radiation would be a greater loss than the more perfect circulation would be a gain, nor so elaborate an arrangement that the interest on money invested would be greater than the gain in economy. The longer life and greater safety of the boiler should be taken into consideration, as well.

An article came to my notice, in which the writer argued against circulation in boilers, claiming that where cooler water was continually sweeping over the heating surfaces it chilled the gases and the carbonic oxide passed off unconsumed; while if the hot water was kept on the fire sheets, combustion would have been completed. When we take into account that the temperature of the gases must not be reduced below some 750°, and that the boiler without circulation would be but 312°, unless the water was lifted bodily off the metal, while if there was good circulation there would be but a slight difference in temperature, and if the combustion was not complete before the gases were brought in contact, they would be put out any way, it will be seen that, so far as combustion is concerned, such an argument would have no weight.

Mr. George H. Barrus read a paper at Nashville in relation to circulation in upright boilers, and explains how he overcomes the trouble of priming, but does not state the difference in fuel. This would have been an interesting item as well, as the question of circulation has a bearing on the life of the boiler and its economy. W. E. Crane.

A Kicking Apprentice.

Editor American Machinist:

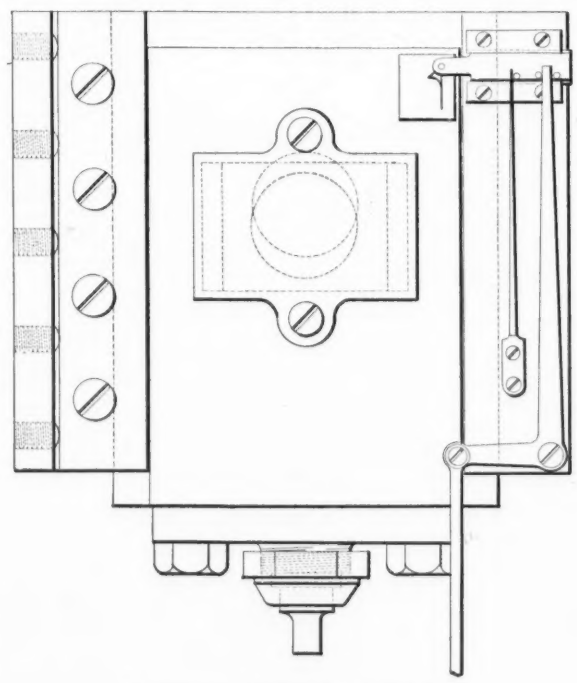
A year had been spent in sweeping the shop, re-cleaning castings, coal-tarring, mill-gearing, and occasionally running a drill press. That sort of work was now becoming somewhat humiliating to an apprentice, and seemed to warrant a complaint at headquarters that we were not being advanced more rapidly.

One day, when "out of a job," he hunted up an old hub of a wheel, and putting it into a vise, dressed a cape chisel and commenced cutting a key-seat in it. About the time this was ready to file out, the "boss" came along and asked what we were doing. He simply told him, with a sort of injured air, that, being out of work, he was just seeing if he could cut a key-seat. He looked through the hole, I suppose to see how much the key-seat resembled a screw. However crooked or winding it might have been, it did not ever again become necessary to hint for more rapid promotion. Chip.

Springing Punching Machines.

By Frank H. Richards.

I read with pleasure and profit, as no doubt did all the readers of the American Machinist, Prof. Sweet's Philadelphia lecture. If the Professor could impart his secret of filling up that warrants his wholesaling his ideas in this reckless manner it would be a great gain to the mechanical world. Such an address is more valuable in the way of suggestion and stimulus than in what it actually presents. A wagon bearing the richest of crops carries no such wealth as the one loaded with seed. This seed will spread far; one little thing will catch and grow in our mind, another little thing will drop in somewhere else and spread itself. One of the smallest of Prof. Sweet's seeds seems to have fallen, perhaps unfortunately, to my lot, and its lodgment in my mind may not enhance its growth. But the growth of mechanical ideas is peculiar, and often, when we think we are digging up weeds, we are only loosening the soil for succulent roots to penetrate.



Springing Punching Machines.

I trust I have learned something of the rare secret of instructive argument, without which secret there is neither profit nor progress—the determination to find out whether I am right or wrong rather than to prove that I am always right. It may savor of conceit to say this, for I hold that not one in a hundred knows the secret, of all the host of humanity, little and big, who are always carrying on their discussions, talked, written or printed, and learning so little from them. Of course I hold it my duty always to state my case as strongly as I can, because if it is wrong I want it to fail through its inherent falsity, and not through the weakness of its advocate, which latter failure leaves the case as unsettled as ever.

Well, Prof. Sweet says that when the frame of a punch springs open, as they will in

punching, all the power it takes to spring it open is lost. Now, I can't see how that can be, and I would like to know.

It all depends upon the distribution and duration of the resistance the punch has to meet in doing its work. I know the total, or, rather, the highest resistance does not begin with absolute suddenness; because every punched hole I ever saw showed some bending over around the edge, and of course it did not take as much power when the bending was just beginning as it did when the metal was bent to the utmost, and the burr to be punched out was just beginning to let go. After the point of greatest tension is reached, if the resistance then ceases instantly and absolutely, if the work is then all finished, of course the spring of the frame is of no use, and goes merely to shoot the burr out of the hole like a shot out of a gun. All that goes to do the shooting is lost, of course; I can understand that, and the way to measure it would be to take a target and compute the penetration of the shots. But it does not seem to me that, in punching, the letting go of the burr can be so sudden that all the spring of the frame is wasted in shooting it out. When it comes to the point, the letting go is a gradual operation, just as the starting is. It is a tearing of the fibers, and the fibers do not all let go at the same instant. Some let go before others, and when some have let go, those that are left are not so strong, and by the time the last fiber has let go the spring may be all gone from the frame of the punch. Certainly some of it has gone, and it has done work in helping to drive the punch through the last part of the hole. The resistance encountered in driving the punch through the metal is first gradually increasing and then gradually diminishing—I suppose one may be more gradual or extended than the other; but while the resistance is gradually diminishing, some of the spring of the frame is being used instead of lost, as the power stored in a balance wheel is used in carrying over the center. If the punch is made shearing, the resistance met and the power used is spread over a larger part of the movement of the punch, and there will be a more gradual increase and a more gradual decrease in the amount of power called for. We might say that when the point of greatest resistance has been reached and the punch is beginning to go easier, and some of the spring is given out of the frame, the punch is actually going through the hole faster than is due to the revolution of the shaft, proving in that way that the spring of the frame is doing some of the work.

I wonder if any one has ever taken a practical diagram from a punch in operation, showing the actual distribution of the power employed at every point in the operation of punching. Of course it has been done in a way. The tables will tell us pretty closely the power it takes to punch anything; but they only tell us the biggest strain that is called for, and that does not satisfy our present need. We want something that will show the strain upon the punch at every point, from the moment it touches the metal until it gets clear through the hole. We could take a screw punch and set it where we had plenty of room to travel around it, and then we could have a long lever that we could pull around with a spring balance and note the reading of the balance at, say, eight or sixteen points in the turn of the screw. That would give us some idea; but the friction of the screw would so complicate the problem as to seriously impair the result.

I would suggest an arrangement something like the accompanying sketch (page 6). On the lower right hand corner of the front of a boiler maker's punch I would mount a little lever, with the long arm of it standing up, and working a little sliding bar rubbing horizontally. This bar should be held back by a spring that would take up the slack, and it should carry a little pencil or a sharp metallic point that would make its mark upon a card on the vertically moving block which carries the punch. From the vertical lever there should be another arm running out horizontally and connected to it a rod attached to the lower part of the frame, or that which holds the die. As this arm would be shorter, say a quarter the length of the other, the little sliding bar carrying the pencil would show four times the actual spring of the frame. If four times were not enough we could make it ten times, or any other desirable ratio. If we wished to make any computations from our card when obtained, the scale of the spring of the frame could be ascertained by prying the frame apart with a weighted lever.

As to the card that would be obtained, it is not necessary to exercise our imagination. There would be a plain vertical mark as long as the whole stroke of the punch, while the mark indicating the spring of the frame in punching would only occupy a little space near the upper end of the straight mark. The general shape of it might be something as hinted in the sketch.

If some of our AMERICAN MACHINIST acquaintances would try it, as could be done at little cost, it would tell us something that a great many mechanics would like to know.

It occurs to me that the fulcrum of the lever should be upon the lower part of the frame, and the motion obtained by attaching to the upper part, the card being upon the sliding block as before, though, perhaps the lower corner of it. Then the vertical spring of the frame would not impair the truth of the card.

A New Method of Mounting Special Emery Wheels.

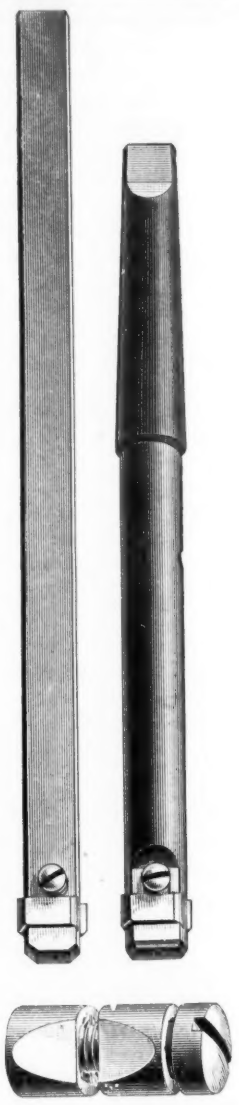
The accompanying cuts show a method of mounting emery and corundum wheels of different sizes and shapes, to the end of a horizontal spindle, for grinding anything which requires the center of the outer side of the wheel to be utilized for grinding for iron hollowware, etc.

It has been the practice of the Sterling Emery Wheel Co. to accomplish this by inserting in the back of the wheel, while in a soft state, a wooden plug on which a thread was cut; this plug being burned out during the baking of the wheel, and leaving a threaded hole which was screwed directly on to the spindle. This plan was open to the objection that the wheels did not always run as true as could be desired, and the thread would pull out, sometimes with unpleasant consequences.

By the improved method the wheels are made with a hole in the back, which is plain, without a thread, and at the bottom is enlarged to form a recess, into which the flange on the sectional nut (Fig. 1) fits. Enough is cut out of each section to allow of their being put into place in the wheel, the one having the key on it, fitting into a corresponding keyway in the wheel. The thread on the inside of the sectional nut fits that on the outside of the thimble (Fig. 2), which, after the sections are in place, is screwed in until the flange is tight against the back of the wheel, and drawing the sectional nut outwards until its flange is also tight in the recess, thus holding the wheel very securely. The thread inside the thimble is made any size to fit the spindle of the machine, onto which it is screwed. The cut, Fig. 3, shows some of the shapes which are mounted in this way.

The makers are the Sterling Emery Wheel Co., 17 Dey street, New York.

The Government of Chili proposes to construct 700 miles of railway.



NEW CHUCK DRILL AND REAMER.

A New Chuck Drill and Reamer.

With this we present cuts showing the construction of an adjustable chuck drill, and an adjustable reamer, made by John Birkenhead, Mansfield, Mass.

The cuts show the two tools complete, and, separately, a cut showing (full size for No. 5 reamer) the screw and bushings by which the cutters are held in place.

It will be seen that transverse dovetailed recesses are made across the tool, opposite each other, into which the cutters fit; their sides being beveled to correspond. Back of these recesses a hole is drilled through the bar, which is just the size of the outside of the bushings, and the head of the screw. These are put loosely into the hole, the beveled flat places on the bushings coming against the beveled edge of the cutters.

The screw is tapped into the lower bushing only, and when it is tightened, both bushings are drawn towards the center, the flats on them coming in contact with, and tightening the cutters firmly in their places.

It will thus be seen that the cutters can be set at any desired size, within the capacity of the tool, and can readily be removed for grinding. A set of five reamers for lathe or drill press will ream any size hole from ½ to 3 inches. Those to be used in the drill press being fitted with Morse taper shanks unless otherwise ordered. Screwdrivers, a rawhide hammer and a gauge for setting the cutters are furnished with each complete set.

Brisben's Emery Wheel Dresser.

The cut herewith shows a new tool for dressing emery wheels and grindstones, the cutters for which are cast in chills, of a composition of spiegel and other metals, so that, while the cutting parts are very hard, the center is soft, and they are bored out to fit the collet upon which they revolve. They can be resharpened several times, and when finally worn out can be replaced at small cost. They are so formed as to avoid the formation of ridges across the wheel or stone. The bolt shown passes through the collet, upon which the cutter revolves, and tightens it against the sides, to prevent its turning. The handle is of malleable iron, 15″ long, and weighs three pounds. It is made by W. W. Brisben, Cleveland, Ohio.

EMERY WHEEL DRESSER.

Personal.

David Spence, well known to our readers as an occasional contributor to our columns, has accepted the position of superintendent of the Sagmore Manufacturing Company, at Valatia, N. Y. Mr. Spence leaves G. W. Brown & Co., of Galesburg, Ill. The *Republican and Register* of that city speaks thus pleasantly of Mr. Spence:

Mr. David Spence, for several years the efficient superintendent of the foundry of G. W. Brown & Co., has resigned his position here, to accept that of superintendent of the Sagmore Manufacturing Company, at Valatia, New York. The company is an extensive one, employing a large number of men. It manufactures mowers and engineers' supplies. Mr Spence is recognized as one of the best versed men in his department in the State. He has been a live, wide-awake citizen, interested in every good work, and for several years has been superintendent of the Mission Sunday School. His leaving here will be much regretted.

A large number of iron barges for the transportation of coal are to be built at Pittsburgh. The day of the wooden barge is probably about over.

Marine underwriters are insisting that vessels shall be moored with hawsers instead of chains. In case of fire it is not practicable to cut chains.

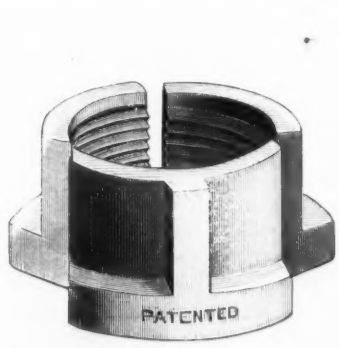


FIG. 1.

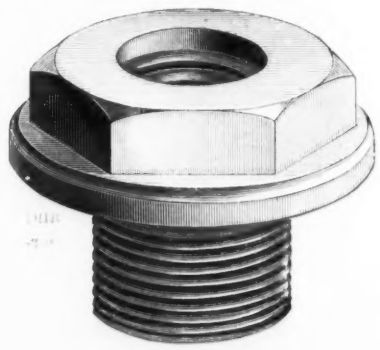


FIG. 2.

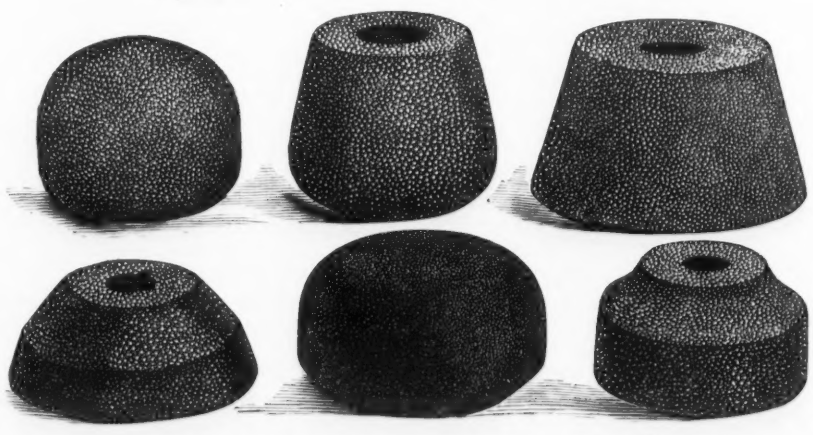


FIG. 3.—NEW METHOD OF FASTENING SPECIAL EMERY WHEELS.

AMERICAN MACHINIST

To prevent delays all Communications should be addressed to the Company.

PUBLISHED WEEKLY

BY

American Machinist Publishing Co.

96 Fulton Street, New York.

HORACE B. MILLER, Pres't and Bus. Manager.
LYCURGUS B. MOORE, Treas. and Sec'y.

F. F. HEMENWAY, Editor and Mech. Engineer.
J. G. A. MEYER, } Associates.
FRED J. MILLER, }

Special Announcements.

☞ *Positively we will neither publish anything in our reading columns for pay or in consideration of advertising patronage. Those who wish to recommend their wares to our readers can do so as fully as they choose in our advertising columns, but our editorial opinions are not for sale. We give no premiums to secure either subscribers or advertisers.*

☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Subscribers can have the mailing address of their paper changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once.*

Subscription.

$2.50 a year in advance, postage prepaid in the United States, Canada and Mexico.
$3.50 a year to Other Countries, postage prepaid.

Advertising.

Transient, 35c. per line, each insertion.
"Business Specials," 50c. a line.

The American News Company,
Publishers' Agents, New York.
The International News Company,
11 BOUVERIE STREET, Fleet Street, LONDON, ENG., will receive subscriptions for the AMERICAN MACHINIST, at 14/7 per annum, postage paid.

DEALERS SUPPLIED BY

The Albany News Company, Albany, N. Y.
The American News Company, New York, N. Y.
The Baltimore News Company, Baltimore, Md.
The Brooklyn News Company, Brooklyn, N. Y.
The Central News Company, Philadelphia, Pa.
The Cincinnati News Company, Cincinnati, Ohio.
The Cleveland News Company, Cleveland, Ohio.
The Colorado News Company, Denver, Colorado.
The Detroit News Company, Detroit, Mich.
The International News Company, New York, N. Y.
The Minnesota News Company, St. Paul, Minn.
The Montreal News Company, Montreal, Canada.
The National News Company, New York, N. Y.
The Newark News Company, Newark, N. J.
The New England News Company, Boston, Mass.
The New Orleans News Company, New Orleans, La.
The New York News Company, New York, N. Y.
The Northern News Company, Troy, N. Y.
The Omaha News Company, Omaha, Neb.
The Pittsburgh News Company, Pittsburgh, Pa.
The Rhode Island News Company, Providence, R.I.
The San Francisco News Co., San Francisco, Cal.
The South West News Company, Kansas City, Mo.
The St. Louis News Company, St. Louis, Mo.
The Toronto News Co., Toronto, Ontario, Canada.
The Toronto News Co., Clifton, Ontario, Canada.
The Union News Company, New York, N. Y.
The Washington News Company, Washington, D. C.
The Western News Company, Chicago, Ill.
The Williamsburgh News Co., Brooklyn, E. D., N. Y.

NEW YORK, JUNE 16, 1888.

CONTENTS.

	PAGE
New Automatic Steam Engine	1, 2
An Excellent Blue Print	2
Design, Construction, Repairs and Management of Marine Steam Engines and Boilers. By W. H. Hoffman. Ninth Paper.	2, 3
Practical Drawing. By J. G. A. Meyer. Fifty-second Paper	3
The Pond Machine Tool Co's Works	4, 5
Burrell's Improved Liquid Fuel Burner	5
Letters from Practical Men: Speed of Special Tools. By Fay—Cylinder Lubrication. By T. T. Parker—Mushet Steel. By J. Torrey—Rope Driving. By Frank B. Cole—Machine Designing. By F. G. Woodward—Curious Behavior of a Tap. By J. P. L.—Circulation in Steam Boilers. By W. E. Crane—A Kicking Apprentice. By Chip	5, 6
Springing Punching Machines. By Frank H. Richards	6, 7
A New Method of Mounting Special Emery Wheels	7
A New Chuck Drill and Reamer	7
Brisben's Emery Wheel Dresser	7
Personal	7
Throttle Heroes	8
The Coming Election	8
Questions and Answers	8, 9
Manufactures	9
Machinists' Supplies and Iron	10

Throttle Heroes.

Bravery in the face of a well-known and fully appreciated danger is always to be admired, of course, simply for itself, and without regard to whether or not the possession of bravery, or the manifestation of it in a particular instance, is beneficial to others or not.

But when a man faces an impending danger to the imminent risk of his life, for the sake of protecting others, whose safety depends upon his bravery, and when by forsaking his post he might avert the danger so far as he is concerned, he becomes a moral hero whom the world delights to honor; and in the history of nations, none occupy a more exalted place than those who have made such sacrifices.

History records deeds on the field of battle where a single act of exalted heroism has decided the fate of nations, and immortalized the memory of him who performed it.

Equal heroism is displayed by the locomotive engineer who, when he thinks the safety of his train demands it, stands firmly at his post and unflinchingly meets death in the performance of his duty.

But, however much we may admire bravery, when shown in a good cause, we can but deplore that kind of bravery which leads a man to sacrifice his life to no possible good purpose; and many of the sacrifices made by locomotive engineers are of this character.

When an engineer sees an obstruction on the track, or perceives that a collision is imminent, his first impulse is to take the proper measures to stop the train. His training and every-day experience on the road make this action second nature to him, and upon becoming aware of danger he will instinctively close the throttle, and apply the brakes, or reverse his engine, and in doing it gives scarcely more thought to the action than to his breathing; it is a matter of training and habit. But after the throttle is closed and the brakes applied, then that is all that can be done, and it is of no possible benefit to him or anyone else for him to stand there and hold to the throttle and air cock, and make a "throttle hero of himself" by being crushed or scalded to death. And, however much we may admire his bravery if he does do so, yet we must admire his judgment and presence of mind less than that of a man who, knowing that he has done all he can for the safety of his train, and seeing that a collision or other accident is unavoidable, jumps and saves himself; and the man who does so by no means proves that he is any less brave than he who sticks to his engine, and dies to no purpose.

When a man has performed his whole duty and done everything possible for him to do, for the protection of those who depend upon him, that is all that is required of him, and there is no cowardice in his protecting himself if possible.

The Coming Election.

We notice thus early some expression to the effect that this being the year in which a presidential election occurs, a falling off in business, to some extent, may be expected. Of all things unreasonable, the reason for such feeling is least apparent. It is one of those phantasies that takes possession of the people of this country, for which no sane man can find a valid excuse in times like these. "As dead as a door nail" is an expression that troubled the genius of Dickens; his trouble would have been greater had he attempted to account for the almost universal feeling in this country that the harmless process of electing a president should operate to stagnate business.

With the country almost equally divided as between the two great political parties, nothing is more ridiculous than the supposition that either of these parties will nominate a man, or that a man can be elected, in whose hands the administration of affairs, so far as it is in his province to administer them, shall not be entirely safe. And we do not suppose that it is through any real fear of this kind that, under ordinary circumstances, business almost invariably feels the effect of a presidential election. The reason is one of sentiment which it would be hard to explain, unless we assume that sensible people believe the sayings of party organs and stump speakers, who send the country to the bad, one way or the other, every four years.

In times of great party issues, when the settlement of grave questions is at stake, it would be possible to find some excuse for the unsettling of business until the settlement by election came. But now, when there is no issue, except in the columns of the daily press, it would puzzle the wisest philosopher to decide what there was about a commonplace political squabble that should affect business.

If, however, any considerable number of people are impressed with the idea that business is to be slow, it will be so, whether it is presidential year, or any other year. It will be slow, because those who believe it is to be so will unconsciously work to that end. Many men make themselves sick through the imagination; business is often depressed through the same cause.

If, on the contrary, every man goes along as if the coming presidential election was to make no difference with his business affairs, it just as surely will make no difference. The latter course is the wise one, but precedent is a hard thing to overcome.

Questions and Answers.

The questions received by us to be answered in our columns have, for some little time past, exceeded the number which we have been able to find room for, and consequently there has, in many cases, been unusual delay in answering them.

Some few of our friends, in writing to know the cause of the delay, have taken pains to inform us that, though their names are not on our subscription books, they are regular readers of the paper, and get it from their newsdealers; seeming to think that we do not care to answer questions unless we know that those who send them are subscribers.

This is a mistake, and we wish to say to all who have any such idea, that we heartily welcome all questions pertaining to our line, from any one, whether subscribers or not. Our paper has a large sale from the news stands, and it is manifestly impossible for us to know whether a questioner is a reader or not, even if we desired. The presumption is that those who send questions to us read the paper; but whether they do or not, makes no difference; all questions are treated impartially upon their merits, without regard to whom they come from.

It should be remembered, however, that the answers to many of the questions involve considerable labor, and in some cases correspondence with other parties, or a visit to a place where certain machines or operations can be seen; and that, on this account, there is frequently some unavoidable delay in answering.

Questions sometimes miscarry in the mails, and on that account any questions not answered within a reasonable time should be repeated.

Then some questions are received without the name and address of the sender; an omission which is fatal to the question.

In sending questions they should be plainly written, on a sheet separate from other matters about which you may wish to write; they should be written on one side of the paper only, and all facts or circumstances which can affect the answer should be plainly stated, and a drawing or rough sketch furnished when necessary to make the matter fully understood. Then the name and address of the sender should be plainly written, and that part of it which it is not desired shall appear in the paper, plainly indicated. They will then be given due attention in their turn, without regard to who sends them.

Here is a suggestion from a well-known engineer to the builder of a high-speed engine, noted for its noiseless operation: Arrange so as to put the engine that drives your works in the office. This will attract the attention of every one who calls on you for any purpose to this feature of your engine.

Another suggestion of the same engineer is that the office should be fitted up neatly in every respect, but not expensively. Expensive decoration, he thinks, shows no evidence of brains, and suggests that money may be foolishly used in building machinery, while a neat, cheap and serviceable fitting up creates the reverse impression. Needless expense suggests to a customer that he will have to help pay for it.

It is gratifying to note that some of the busiest boiler works in the country are those that have given up all attempts to compete with the "cheap John" builders. These works insist upon a price that will cover the cost of good work and good material, and the fact that they are getting a good supply of orders is evidence that buyers realize, to some extent, at least, that there is about as much difference in boilers as there is in watches, for instance. It is solid satisfaction to see a boiler maker who practices honest work full of orders. It denotes progress.

The people of this country will do well to note the agitation that is going on in England in favor of inland water ways. This agitation is caused by the greediness of the railway corporations, which make their freight tariffs so high that manufacturers away from the seacoast have little hopes of competition. This is having the effect to drive manufacturers to the seacoast, or to other countries. The plain moral of this, as applied to this country is, preserve all means of inland communication by water.

A contemporary heads an article: "Gas Meter Capacity." The average opinion will always be that a gas meter has a capacity just about equal to the financial capacity of the man who pays the bill. No amount of argument will change this opinion.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(289) G. E. Berry, Williamstown, W. Va., asks: How do you calculate the pressure on an ordinary slide valve—by the pressure on the whole number of square inches covered by the valve, or is the pressure equal only to the number of square inches in openings under the valves? This is a question which is causing considerable discussion among the engineers of this vicinity. *A.*—The unbalanced pressure, tending to press a valve to its seat, depends not only upon its area, but also upon the relation which its total area bears to the area of the openings in the valve and seat. Then, too, it is not only the steam chest pressure which must be considered, but its relation to the pressure under the valve. It is an interesting subject, and for full information regarding it we advise you to read a paper by Prof. Robinson, published in the AMERICAN MACHINIST, June 2, 1883.

(290) M. B., Allegany, N. Y., asks: 1. Is the circulating fire-box boiler any better than one with open bottom? *A.*—We prefer the open bottom, and fail to see any advantage in a circulating bottom. 2. Would it not be better to place a feed pipe under the center of barrel, and let it project well up into the barrel, than to place it under the grate of fire-box? *A.*—The feed-water will in many cases carry into the boiler some impurities, part of which will settle at the bottom near the entrance of the feed-water. It is therefore necessary to allow the feed-water to enter the boiler above these sediments. It is also good practice to enter the feed into the cold part of the boiler. Consequently in boilers of the locomotive type, or other horizontal boilers, the feed-water should enter at the side, near the end of the barrel opposite to the fire-box, or grate. 3. Will a friction pulley with a 6-inch face pull as heavy a load as one with a 3 inch face, all other dimensions remaining the same? *A.*—So long as the pressure does not produce abrasion, both wheels will pull with an equal force; but the one with a 3-inch face will wear faster than the one with the 6-inch face. Your fourth question we do not understand. 5. Will a traction engine pull more with the driving pinion on top of the spur gear, than with the driving pinion placed at the side of the spur wheel. *A.*—No.

(291) H. G., Albany, N. Y., writes: I am building a machine for pressing sheet-iron. I notice that Bliss & Co., Brooklyn, and others, transmit motion from the shaft by means of a crank. What advantage is there in that method over trans-

mitting by an eccentric? *A.*—There is no difference if the throw is the same; and in fact, in the kind of machinery of which you speak, it is hard to define the difference between a crank and an eccentric, or to tell just when a crank becomes an eccentric, or *vice versa*. Take such a machine having what you call a crank, and, leaving everything else the same, increase the diameter of the wrist-pin until its radius exceeds the distance from the center of the shaft to the center of the pin, plus the radius of the shaft; it would then be regarded, according to usual practice, as an eccentric; yet nothing has been changed except the wrist-pin diameter, and the only difference in its working will be in the matter of friction, which will be somewhat greater, provided the pin was originally large enough to ensure good lubrication at all times.

(292) S. M. R., Augusta, Ga., sends a sketch of a blade such as is used in patent cut-off tools, and wants to know why the back end won't cut as well as the other, if ground with the same clearance? *A.*—It will, if it is tempered as well, but that is probably not the case.

(293) E. E. T., Newark, N. J., writes: I have built a compound engine for a boat. Cylinders 3½" x 5", and 8" x 5". I have keel condenser air pump 8" x 8". Will I get good results with this engine? Also state size of boiler to make plenty of steam. *A.*—You do not state the size of boat, or the amount of work the engine will have to perform; consequently we cannot answer your questions.

(294) V. W. & Co., Paterson, N. J., asks: What is the cause of some belts making a horrible screeching noise when shifted from the loose to the tight pulley, and what is a remedy? *A.*—The cause of the noise is slipping of the belt on the pulley, and anything which diminishes the slipping, diminishes the noise. This may be done sometimes by tightening the belt. But if the belt is tight enough, give it plenty of belt oil, which will be almost sure to stop the noise, and will benefit the belt.

(295) F. G. H., Beaver Falls, Pa., asks: To what depth should studs and machine screws be screwed into cast-iron? *A.*—Studs and machine screws, which are seldom if ever required to be taken out of the pieces into which they are screwed, should extend into the cast-iron to a depth equal to about 1½ times the diameter of the studs. If the screw bolts or studs must be frequently removed, and the pieces into which they are screwed remain stationary, the screws should extend into the cast-iron to the depth equal to about twice the diameter of the screw. If the pieces into which the screw bolts are screwed have a high rate of reciprocating motion, such as locomotive pistons, the studs and screw bolts should extend into the cast-iron to a depth equal to about three times their diameter. Of course these are arbitrary rules, and may have to be changed for special cases.

(296) E. L. R., Mobile, Ala., asks: In what form is aluminum found in nature; by what process extracted? *A.*—Aluminum is the metallic base of alumina, which is found in great abundance in the earthy siliceous minerals, such as the micas, feldspars, etc., and in common clay. It is separated from the chloride by bringing to a red heat a mixture of the double chloride of aluminum and sodium, or the double fluoride of aluminum (cryolite) and sodium, with the metal sodium. Where it is extracted on a large scale, the reduction is effected in a reverbatory furnace; 10 parts of the double chloride, 5 parts of cryolite and 2 parts of sodium being placed on the hearth. It may also be separated from the double chloride by electrolysis. In this method the salt, after fusion, has an electric current passed through it, carbon poles being used. The negative pole collects the metal in large globules which are afterwards melted together under a layer of fused salt.

(297) Subscriber, Southampton, Ont., writes: We are at present engaged in building a steam barge, the dimensions of which are 125 feet long, 26 feet beam, and 9½ feet depth of hold. Will an engine 20" x 20", boiler 14 feet long, and 7 feet diameter, with 90 flues 3 inches in diameter, be ample and powerful enough to propel her at the rate of 10 miles an hour? Some parties state we have not power enough, while others state we have. Is there any standard rule amongst marine engine builders as to the power that should be required in a boat of a given length, breadth and depth of hold? *A.*—The power required to propel your barge depends greatly upon the shape of her lines, and since these are not given, and the description of boiler very indefinite, it is impossible for us to state any positive opinion on the power. But it seems to us that the engines are too small for the purpose. In John W. Nystrom's pocket-book of mechanics, you will find tables which will enable you to estimate approximately the power required.

(298) D. W. G., Birmingham, Ala., writes: I intend to take out a patent for a steam reverse arrangement or link shifter for locomotives. The area in the cylinder of this machine is the same in both ends, with boiler pressure in each end. Is it possible for the link in its vibratory motion or back-lashing, to move the piston in the reverse cylinder? In other words, is it necessary to have an oil cylinder to prevent any possible movement? *A.*—With steam in the reverse cylinder the link cannot be held in position at all times as it should be. In the cylinder you must have some comparatively incompressible substance, such as oil or water, to hold the piston in place. 2. What do you consider the advantages to be of these machines over the old style of reverse lever—will these machines come into general use? *A.*—On locomotives, having large slide valves and high steam pressure, it is often found to be a laborious undertaking to reverse the engine or move the link from one position to another with an ordinary reverse lever, hence the use of the reverse cylinders with which the engine can be more quickly reversed, and with less exertion of the engineer. We believe that the reverse cylinders will not take the place of the reverse lever in locomotives which can be easily reversed with the ordinary lever.

(299) S. E. F., Philadelphia, Pa., writes: I would be pleased to know the best angle to grind twist drills for quick work. We have a Sellers grinder, and can adjust to any angle. Our drills range in size from ¼ inch to 2 inches inclusive. *A.*—Twist drills should be ground to such an angle as will give them a straight lip; and this angle varies in different makes of drills, being determined by the shape of the cutter used and the angle of the spiral. A drill which, when ground at one angle, will have a straight lip, will, when ground at another one, have a curved lip, and manufacturers use such a combination of shape of cutter, angle of spiral and angle of lip, as to produce a straight lip. In the AMERICAN MACHINIST of Sept. 4, 1880, there is an article on this subject by Mr. Geo. R. Stetson, in which 31° is assumed as the proper angle, and as Mr. Stetson is the superintendent of the Morse Twist Drill and Machine Co.'s Works, it is to be presumed that their drills have straight lips when ground to that angle. It has been claimed, however, that 29° 30′ is the best possible angle. In the AMERICAN MACHINIST, of Jan. 8, 1887, is an article by Fred J. Miller, in which the shape of a cutter and the method of forming it are shown, which makes a straight-lipped drill when the angle of the spiral is 20° and the angle of lip 30°. It is probable that the best angle for general purposes is about 30°. But circumstances sometimes change this. For instance, if the holes must be started from a center-punch mark, a drill ground to a much sharper angle will have less tendency to "run," but after it gets fairly started, and especially if it is to encounter hard spots or blow holes, it will go much straighter if ground quite flat. You will find, however, that most drills are so made that when ground to about the angle we have mentioned, the lips are straight, and for general purposes it is probably best.

(300) Inventor, Rochester, N. Y., writes: Please give me a rule for finding the diameter of a gear wheel, when the arc or circular pitch and the number of teeth are given. *A.*—Multiply the circular pitch by the number of teeth, and divide the product by 3.1416, the quotient will be the diameter of the pitch circle. For cut gearing, the pitch circle and size of blank are almost universally found by the diametral pitch. The diametral pitch is equal to the quotient found in dividing the diameter by the number of teeth in the wheel; we may also find the diametral pitch by dividing the circular pitch by 3.1416 Hence we have

$$\text{Diametral Pitch} = \frac{\text{Diameter}}{\text{No. of Teeth}} = \frac{\text{Circular Pitch}}{3.1416}$$

Consequently, the diameter of the pitch circle is equal to the product obtained by multiplying the number of teeth by the diametral pitch; and the diameter of the blank will be equal to the product obtained by multiplying the sum of the number of teeth plus two teeth by the diametral pitch. Thus: It is required to find the diameter of the pitch circle, and also the diameter of a blank for a gear which is to have 30 teeth, ½ inch circular pitch.

$$\text{Diametral Pitch} = \frac{1.5}{3.1413} = .4775$$

Diameter of pitch circle $= 30 \times .4775 = 14.325$ inches diameter and diameter of blank $= (30 + 2) \times .4775 = 15.28$ inches. When the diameters of gear wheels are determined by the diametral pitch we generally select convenient values for the diametral pitch, as 1, ½, ¼, ⅛, etc. Here it is seen that in these fractions, unity (1) is used for the numerator, and an integer for the denominator. In practice the denominators of these fractions are only used, from which are derived the expressions as 4-pitch wheel, 8-pitch wheel, etc., which simply means that the first wheel has 4 teeth for each inch of diameter and the second has 8 teeth for each inch of diameter. Hence when it is required to find the diameter of a blank for an 8-pitch wheel having 38 teeth, we simply add 2 to the number of teeth, and divide the sum by the number of teeth in one inch of diameter, thus:

$$\frac{38 + 2}{8} = 5 \text{ inches.}$$

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

See Grant's Gear advt. on back page.

Link-Belting.
Send for Catalogue of Link-Belting.
Over 50,000,000 feet of Link Belt in use.
Link Belt Machinery Co., Chicago and N. Y.

Taper attachment on all lathes — Lodge, Davis & Co
Compound rest on all lathes — Lodge, Davis & Co.
Power cross-feed on all lathes — Lodge, Davis & Co.
Large hollow spindle on all lathes — Lodge, Davis & Co.
Automatic stop on all lathes — Lodge, Davis & Co.
See special ads. pages 15 and 16 — Lodge, Davis & Co.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Lamb Knitting Machine Co., Chicopee Falls, Mass.

Machine work and pattern making. Anderson Machine Works. Peekskill, N. Y.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Improved fine tools for mechanics, manf'd by L. S. Starrett, Athol, Mass. Send stamp for full list.

"Swift" Sight-feed Lubricator: no glass tubes: simple, reliable. Swift Lub'r Co., Elmira, N. Y.

Davis Key-Seating Machines, kept in stock, by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Burnham's turbine wheel is sold at net price to mill owners. Catalogue free. Address York, Pa.

Selden packing, for stuffing-box, with or without rubber core Randolph Brandt, 38 Cortlandt st., N.Y.

The bulldozer, a new departure; forging by pressure. M't'd by Williams, White & Co., Moline, Ill.

Patents—Whittlesey & Wright, 705 8th st., N. W., Washington, D.C. Send for pamphlet and references.

Brown & Sharpe Mfg. Co. have a line of machinery with S. A. Smith, 23 S. Canal st., Chicago, Ill.

Ice and Refrigerating Machines, 124 built, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago. Ill.

Engine lathes, hand lathes, fine tools, files and supplies for machinists and other metal workers. Frasse & Co., 92 Park Row, N. Y.

Artesian, salt and oil well pumps; sucker rods and deep well supplies: wrought-iron tubing and steam pipe. Hardwicke & Ware, Buffalo, N. Y.

Model Engines and Castings. Prices $3.75, $4.75 and $5.75. For descriptive circular apply to Montgomery & Co., 105 Fulton street, New York city.

Curtis Pressure Regulators, Curtis Return Trap, Curtis Damper Regulator. See June 9, p. 10. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

Robertson's damper regulator; no diaphragms, springs or packing: the cheapest good regulator in market. Hine & Robertson, 45 Cortlandt st., N. Y.

Machinists' supplies, brass goods, m'f'rs supplies, polishing materials, all kinds wire, metals, etc., in any quantity. Jordan & Gottfried, 208 Canal st., N.Y.

For Best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves. T. Kieley, 11 W. 13th st., N. Y. Send for des'n.

Patent Att'y. R. G. DuBois, 916 F. st., Washington, D. C. Reliable service at reasonable rates. Send for 38-page pamphlet containing list of references.

How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

For automatic car wheel molding machine, for the manufacture of double and single plate wheels address, Wilkes-Barre Molding Machine Company, Wilkes-Barre, Pa.

W. H. Hoffman, consulting engineer, 108 Liberty st., room 3, N. Y. Mechanical engineering in all its branches; working drawings for the transmission of power by steam, water, air and electricity.

Parties requiring milling machine or screw machine work furnished, in large or small quantities, please write to the manufacturers, E. E. Garvin & Co., 139, 141, 143 Centre st., New York City.

The Dieble Mfg. Co., Philadelphia, Pa., mfrs. of the Challenge emery grinding and polishing machinery, invite correspondence with all needing this class of machinery. Catalogues and prices on application.

Contract work of all kinds executed promptly and on reasonable terms. Parties wishing gray iron castings in large quantities can make money by corresponding with Rawson Mfg. Co., Hornellsville, N. Y.

A practical treatise on the steam engine, by Arthur Rigg, essays on the principles involved in design and construction of fixed engines; 312 pages, with 96 plates. 4to, cloth, $10.00. E. & F. N. Spon, 12 Cortlandt st., N. Y.

For the manufacture of
Patented articles in line of machine work;
Specialties in fine light machinery;
Accurate cam cutting;
Address Wardwell S. M. Co., Woonsocket, R. I.

James D. Cardell & Co., 1900 Passyunk ave., Phila., Pa., boiler makers and sheet iron workers, m'f'rs of coils of wrought-iron pipe, return bends, etc. Address after June 15, Rising Sun Lane and North Penn. R. R. Boiler repairs promptly attended to.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, the full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G Co., 96 Fulton st., New York.

The series of articles by J. G. A. Meyer, on "Practical Drawing," now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including June 2, 1888 issue, 51 articles have been so far published. Copies containing these articles, sent by mail to any part of this country or Canada, at 5 cents each. AMERICAN MACHINIST PUBLISHING Co., 96 Fulton st., New York.

"Modern Locomotive Construction," by J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 65 articles have thus far appeared up to and including the May 26, 1888 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING Co., 96 Fulton st., New York.

MANUFACTURES

Taylor & Terry will build a saw mill at Koenton, Ala.

Henry Carter will build a planing mill at Childersburg, Ala.

The Triggs Furniture Company has been organized at Fort Smith, Ark.

J. P. Russell will build a sash, blind and door factory at Washington, La.

It is reported that Adam Ferg will at once build extensive car works at Bristol, Tenn.

The Gray Clock Company has been incorporated to manufacture clocks and watches at Alexandria, Va.

The Sheffield (Ala.) Agricultural and Machine Works will increase their capacity by adding new tools.

The Union Foundry and Machine Company, Pittsburgh, Pa., have begun making machine-moulded gearing.

The Cleveland and Mahoning Railroad Company will build shops at Youngstown, Ohio, to employ 250 men.

The Mexican Railway has made large contracts for steel ties. Eventually we may learn something from our friends nearer the equator.

Harrison Soule will build an iron and brass foundry 32 x 60 feet, at Rochester, N. H. The new foundry, is required by his rapidly increasing business.

The Gibson Electric Company, 775 Greenwich street, New York, has issued a circular descriptive of storage batteries for street cars, electric lighting, etc.

A company is to be organized to manufacture a new gas machine, the invention of Alfred Langdon, Detroit, Mich. The gas is made from crude petroleum.

The Cleveland (Ohio) Twist Drill Company write us: Orders have been very brisk with us for the past four months, and we are running overtime, to keep up with the demand.

A. B. Jewell, Livermore Falls, Me., writes that Jewell & Keene have their foundry at that place completed, and are at present melting three times a week, doing general jobbing work. Prospects are good for plenty of work.

Extensive alterations are being made in the machine shops of the South Brooklyn Steam Engine Works, and when new tools are added the company will make their machine business more general than heretofore. They will, however, continue to make a specialty of surface condensers.

New water works, or the enlargement of existing works, are contemplated at Jefferson City, Mo.; Salt Lake City, Utah; Wakenburg, Col.; Belleville, Kan.; Ligonier, Ind; Plymouth, Ind.; Helena, Ark.; Hempstead, L. I.; Sutton, Neb.; Ennis, Tex.; Weatherford, Tex.; Herrington, Kan.; Oberlin, Kan.

The International Boiler Company, P. O. Box 2343, New York, have introduced several of their Field-Stirling boilers, and from the results obtained are preparing to enter into their manufacture on an enlarged scale. In this boiler the Field drop tube is employed, but the arrangement and modifications have been worked out by Allan Stirling.

The articles of the Quincy, Ill., Tanning Company were recently filed. The incorporators are Isaac Lesem, Thomas Hill and Henry Gorman. The object for which the company is formed is to establish, operate and maintain a tannery for tanning and the manufacture of leather The capital stock is fixed at $10,000, with 100 shares, and the duration of the company is fifty years. The stockholders are: Herman Hirsch, $1,500; Thomas Hill, $1,500; Isaac Lesem, $3,000; Henry Gorman, $3,000; Andrew Burman, $500; and Arthur Mercier, $500.

The Taylor Manufacturing Company, Chambersburg, Pa., builders of the Beck automatic engine, pay particular attention to the manufacture and erection of complete steam plants. They report the following sales: A 100 horse-power steam plant for electric light plant at Coldwater, Mich.; a 100 horse-power plant for an electrical street railway at Columbus, Ohio; a 250 horse-power complete steam plant for the Schuyler Electric Light station at Hagerstown, Md.; a 67 and 57 horse-power steam plant for operating Thomson-Houston electric light plants at Frederick, Md., and Reidsville, N. C., respectively; a 150 horse-power steam plant to lumber firm in Louisville, Ky.; also numerous other orders for Beck automatic engines for general purposes ranging in horse-power from 35 to 150. This company have added new and improved machines for facilitating the production of their work recently, and now have thoroughly equipped shops.

The Phœnix Iron Works, Meadville, Pa., have more business than they can attend to by working all the overtime their men can stand, and have been obliged to get a good deal of work done outside their shops. Steam engine and boiler work is what is driving them. They will, from present appearances, turn out four hundred boilers this year. Their boiler business does not come from cut prices, but from the reputation this company has for first-class work and the best material. This company use natural gas for steam making, also for blacksmith furnace and for their core oven. It is an excellent fuel for this latter purpose, keeping the oven at just the constant temperature required, and avoiding dust and dirt. They dry their cores in this oven in a surprisingly short time. Their experience is that, with natural gas for steam making, the capacity of boiler is increased fifty per cent.

A new company has been incorporated at Grand Rapids, Mich., known as the Michigan Feed-Water Heater and Purifier Company, with a capital of $100,000. The stockholders are Samuel H. Burrell, of St. Louis, Mo., John Widdicomb, James G. McBride, William Dunham, Charles R. Sligh, Ezra T. Nelson, Jay D. Utley, William A. Berkey, Elias Matter, W. H. Jones, of Grand Rapids. The following were elected directors: Samuel H. Burrell, Wm. Dunham, Elias Matter, Charles R. Sligh, John Widdicomb, James G. McBride, Wm. A. Berkey; Mr. Wm. Dunham was elected president; Elias Matter, vice-president; John Widdicomb, treasurer; James G. McBride, secretary. It is the purpose of the corporation to manufacture and sell a new patented device for heating and purifying water for steam boilers and for the prevention and removal of scale from steam boilers. The new company expect to commence operations at once.

Machinists' Supplies and Iron.

NEW YORK, May 31, 1888.

Iron—American Pig—The general condition of the market is dull, and an unsettled feeling prevails throughout the industry. We quote Standard brands $18 to $18.50 for No. 1 X Foundry; $17 to $17.50 for No. 2, and Grey Forge $15.75 to $16.25.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Wanted—Men to examine S. S. planes; see p 11.

Wanted—By a wood pattern maker, a steady job. Address W. K., Box 16, Belmont, N. Y.

Mechanical draftsman with experience wants a position. Address M. O. P., AM. MACHINIST.

Situation wanted by pattern maker, accustomed to general machine work. R. S., AM. MACHINIST.

Wanted—Foreman to take charge of machine shop who is thoroughly conversant with engine and jobbing work; state age, experience and references; first-class opportunity for proper party. Address Iron Works, care Savage & Farnum, Detroit, Mich.

Wanted—A good, competent superintendent in a wood-working machinery manufactory; must understand the building of wood-working machinery, handling of men, drafting and designing of new machinery if necessary; reference required. Address Pennington Machine Works, Fort Wayne, Ind.

✢ MISCELLANEOUS WANTS. ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Crescent Boiler Tube Expander; second to none. price in reach of all. Crescent Mfg. Co., Cleveland, O.

The Crescent Link Belt Coupling; something new; sample free. Crescent Mfg. Co., Cleveland, O.

Wanted—Parties having machinery specialties to build, to correspond with. BOX 75, AM. MACHINIST.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Correspondence solicited with parties having machine or foundry specialties to build. Honesdale Iron Works. Honesdale, Pa.

Wanted—To buy second-hand lathes, planers and shapers of all sizes; must be cheap and in good order. Fosdick & Plucker, 6th and Culvert streets, Cincinnati, Ohio.

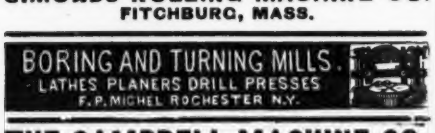
For Sale—A first-class 3-ton cupola, with all connections in perfect repair. also a No. 4 Sturtevant blower, never worked, 30 days. Address F. G. Mott, Bouckville, Madison Co., N. Y.

For Sale.—Horizontal tubular boiler, 6 x 18 feet; 80 four-inch tubes, steel shell, nearly new; two slide valve engines, Burdon pattern; one 15 x 36, one 12 x 24; can be seen running at 30 Tiffany pl., Brooklyn.

August C. Christensen, M. Am. S. M. E., 24 State st. (Battery), N. Y.; 463 Henry st., Brooklyn. Working drawings and superintending the building of machinery; steam, pumping and gas engines indicated.

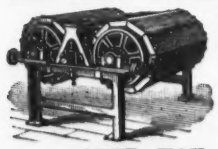
For Sale—A 400 horse-power vertical engine, 22 inch diameter, 30 inch stroke, 10 inch steel shaft, two pulleys, 12 feet diameter each, for 18 inch belt. Automatic cut-off, balanced steam valve, speeded for 150 revolutions per minute. Weight, 65,000 pounds. Designed and built by Prof. John E. Sweet, of the Straight Line Engine Co. A first-class machine, practically new. Address W. B. Cogswell, Gen'l Manager, The Solvay Process Co., Syracuse, N. Y.

STEEL BALLS
FOR ANTI-FRICTION BEARINGS,
OF BEST CAST STEEL.
HARDENED GROUND & BURNISHED.
8-16" to 3" Diameter.
Samples and prices on application.
SIMONDS ROLLING-MACHINE CO.
FITCHBURG, MASS.



THE CAMPBELL MACHINE CO.
is very thoroughly equipped to do first-class machinist work, in experimenting, model making, and building of all kinds of fine light Machinery and Tools.
Superior Workmanship at Reasonable Prices.
Address CAMPBELL MACHINE CO.,
PAWTUCKET, R. I.

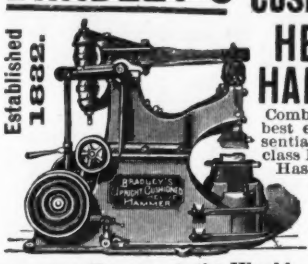
Exhaust Tumbling Barrels.



Henderson Bros.
MANUFACTURERS,
WATERBURY, CT.
SEND FOR CIRCULAR.

MONTGOMERY & CO.,
105 FULTON ST., NEW YORK,
TOOLS, SUPPLIES AND MACHINERY
FOR ALL BRANCHES OF THE MECHANICAL TRADES.
Illustrated Catalogue (300 pages) mailed on receipt of Fourteen Cents.

BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER



Combines all the best elements essential in a first-class Hammer. Has more good points, does more and better work and costs less for repairs than any other Hammer in the World.

Bradley's HEATING FORGES

With a manufacturing experience of over half a century, we recommend these machines to be the best, simplest, most durable and combining all the essential elements.

For hard coal or coke. Indispensable in all shops to keep Bradley's Cushioned Hammers and men fully employed and reduces cost of production.
BRADLEY & CO., Syracuse, N. Y.

STEPHENS VISES.

ONE HALF TIME and LABOR saved by using this solid, strong, durable, firm-hold, quick-working Lever (Not Screw) Vise. Has improved Taper-Pipe and other attachments. Sold by the trade. Send for circular.
TOWER & LYON,
95 Chambers Street, New York.
Successors to MELVIN STEPHENS.

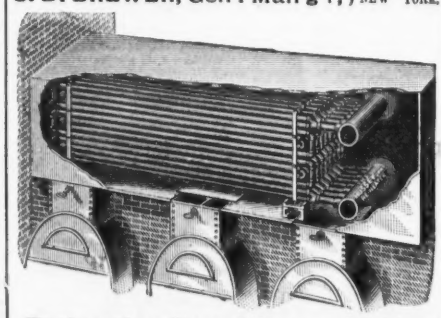
TANITE EMERY WHEELS and GRINDING MACHINES
FOR SAW MILLS, FOUNDRIES AND MACHINE SHOPS.
For Circulars address
THE TANITE COMPANY, STROUDSBURG, MONROE CO., PA.
Or H. A. ROGERS, 19 John St., N. Y.

"Star" Foot Lathe Swings 9x25 in. — LATHE — Screw Cutting Automatic Cross Feed, etc.
Scroll Saws, Circular Saws, Lathes Mortisers. — Catalogue Free of all our Machinery.
Seneca Falls Mfg. Co. 687 Water St., Seneca Falls, N.Y

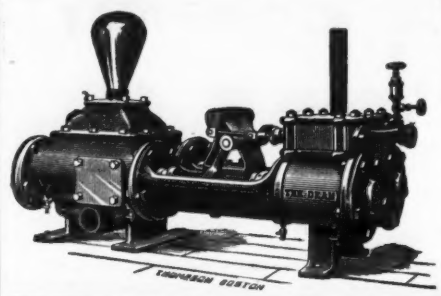
American Standard Gauge & Tool Works, Wilmington, Del.
Makers of Implements for Standard Measurements.

Over 35,000 in Use.
Crescent Gauge. Flat Bar Gauge.
JAS. A. TAYLOR & CO.

THE HUSSEY RE-HEATER
and STEAM PLANT IMPROVEMENT CO.
A. S. HATCH, President, } 15 Cortlandt Street, NEW YORK.
S. D. BREWER, Gen'l Man'g'r, }



Engineering, Steamfitting, and Designing, Remodeling and Improving Steam Plants. Consulting experts in all matters pertaining to the use of Steam and Heat.



THE DEANE STEAM PUMP CO.,
HOLYOKE, MASS.,
New York, Boston, Chicago, Philadelphia, St. Louis,
Manufacturers of
STEAM and POWER
PUMPS
FOR ALL PURPOSES.
SEND FOR CATALOGUE.

MACHINE TOOLS ON HAND FOR IMMEDIATE DELIVERY.
15in., 24in. and 25in. Pillar Shapers. 15in. and 20in. Traverse Shapers, 10in., 16in. and 22in. Planers. 18in. x 6, 8, 10 or 12ft. Engine Lathes, (New Pattern.) 10, 12 and 15in. Speed Lathes. Larger size Planers at short notice. Also our Forming Lathe for special brass work. A few 2d hand tools also on hand.
THE HENDEY MACHINE CO.,
TORRINGTON, CONN.

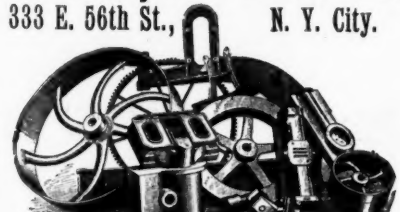
THE REASON
You now find so much CRESCENT STEEL used in large shops, where results are closely watched, is on account of the superior quality and quantity of work done by tools made from it.
MILLER, METCALF & PARKIN,
Western Office and Warehouse, 64 and 66 So. Clinton St., Chicago. CRESCENT STEEL WORKS, Pittsburgh, Pa. Eastern Office and Warehouse, 480 Pearl St., New York.

Sebastian, May & Co.'s Improved Screw Cutting FOOT AND **LATHES** POWER

Drill Presses, Shapers, Band, Circular and Scroll Saws. Machinists' Tools and Supplies. Lathes on trial. Catalogue mailed on application.
167 West Second Street, CINCINNATI, O.
OUR NEW 18 In. POWER ENGINE LATHE IS NOW READY

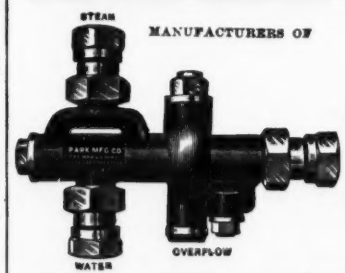
GUILD & GARRISON, Kent Ave. and South 10th St., Brooklyn, N.Y.
Builders of Steam Pumps, Vacuum Pumps, Vacuum Apparatus, Filter-press Pumps, Air Compressors, etc.

Iron Foundry of T. Shriver & Co.,
333 E. 56th St., N. Y. City.



Nice Castings, Smooth and True to Patterns, of very best brands of Pig Iron.
CASTINGS IN QUANTITY AT FAVORABLE PRICES.

PARK MFG. CO.



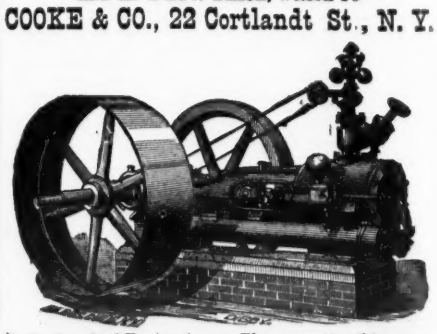
MANUFACTURERS OF
34 Beach Street, Boston, Mass.
The Park Injector,
EJECTORS AND JET APPARATUS.

BALDWINSVILLE CENTRIFUGAL PUMP WORKS.

IRVIN VAN WIE, Prop.,
SYRACUSE, N. Y.
VERTICAL,
Horizontal & Suction Pumps.
Capacity 100 to 40,000 gals. per minute.
Sand Pumping Outfits a Specialty.

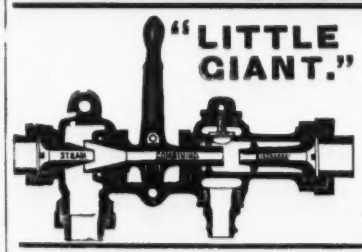
"Twenty Years with the Indicator."—2 vols., $3.00. By THOS. PRAY, JR., C. & C. E. and C. & M. E. Six thousand sold. J. Wiley's Sons, 15 Astor Place, N. Y., or Thos. Pray, Jr., P. O. Box 2728. Boston. Mass.

IF YOU WANT A STRONG, ECONOMICAL
ENGINE
EITHER HORIZONTAL OR VERTICAL,
FOR STEADY EVERY DAY AND ALL-NIGHT SERVICE AND AT A LOW PRICE, *WRITE TO*
COOKE & CO., 22 Cortlandt St., N. Y.

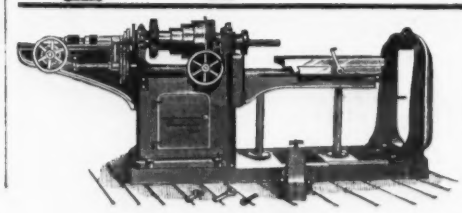


Twelve hundred Engines in use. Please mention this paper

For Pressure and Vacuum Gauges of every description, Exhaust Steam, and other injectors, Address,
SCHAFFER & BUDENBERG,
40 John Street, New York.



"LITTLE GIANT." THE BEST INJECTOR.
For Feeding all Steam Boilers.
RUE'S EJECTOR,
Superior to all others for Raising and Forcing Water and other Liquids.
RUE M'F'G. CO., PHILA., PA.
CATALOGUES FREE.



BETTS MACHINE COMP'Y,
WILMINGTON, DEL.,
MAKERS OF
Metal-working Machine Tools
OF SUPERIOR QUALITY,
FOR USE IN
MACHINE & RAILWAY SHOPS.

GEO. F. BLAKE MANF'G CO
BUILDERS OF EVERY VARIETY OF

95 & 97 LIBERTY ST., NEW YORK. 111 FEDERAL ST., BOSTON.
WATER WORKS PUMPING ENGINES A SPECIALTY

NICHOLSON FILE COMPANY,

PROVIDENCE, R. I.

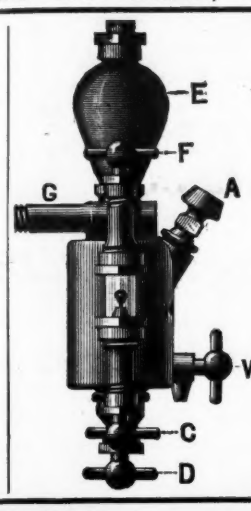
Files and Rasps,

OF EVERY VARIETY, INCLUDING THEIR

TRADE
EXTRA X.F. FINE.
MARK.

FOR FINE TOOL MAKERS, JEWELERS, SILVERSMITHS, WATCHMAKERS, ETC.

Steam Pipe.



THE "VOLUNTEER"
UP-DROP, SIGHT FEED, LUBRICATOR,

(GATES PATENT.)

For Stationary Engines and Pumps of all kinds. Lubricators for Single or Double Connection.

PRICE LIST.

Nos.	1	2	3
Price	$10.00	$12.00	$15.00
Capacity	½ pt.	½ pt.	¾ pt.

NATHAN MANUFACTURING CO.,
92 & 94 LIBERTY STREET, NEW YORK,

Send for Catalogue. SOLE MANUFACTURERS.

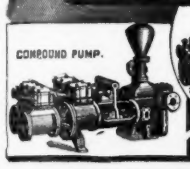
Established in 1874.

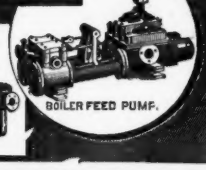
CLEVELAND TWIST DRILL CO.

24 and 26 West Street, Cleveland, O.
101 Chambers Street, New York.
85 Queen Victoria St., London, Eng.

THE VOLKER & FELTHOUSEN M'F'G. CO.
MANUFACTURERS OF
BUFFALO DUPLEX STEAM PUMPS.
HURON BTWN. ALLEN & MICHIGAN STS. BUFFALO, N.Y.

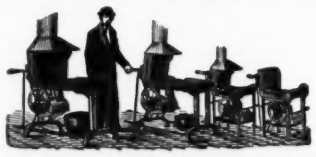
For Sale at Factory Prices by





A. Aller, New York; S. C. Nightingale & Childs, Boston; Henry I. Snell, Philadelphia; Thos. J. Bell & Co., Cincinnati; Shaw, Kendall & Co., Toledo; The George Worthington Co., Cleveland; Goulds & Austin, Chicago; Kennedy & Pierce Machinery Co., Denver, Col.; Sheriff & Ashworth, Pittsburgh, Pa.; Jos. Baur, Manistee, Mich.; Jas. Jenks & Co., Detroit; Wickes Bros., East Saginaw; Adolph Leitelt, Grand Rapids; E. F. Osborne & Co., St. Paul, Minn.; Rundle, Spence & Co., Milwaukee; Joshua Hendy Machine Works, San Francisco; Flynn & Emrich, Baltimore; Forbes, Liddell & Co., Montgomery, Ala; Bailey & Lebby, Charleston, S. C.; Pond Engineering Co., St. Louis and Kansas City; O. B. Goodwin, Norfolk, Va.; Columbus Supply Co., Columbus, O. C. S. Leeds & Co., Minneapolis; H. D. Coleman, New Orleans.

P.H.&F.M. ROOTS,
Connersville, Indiana,
MANUFACTURERS OF
PORTABLE FORGES, TUYERE IRONS, ETC.

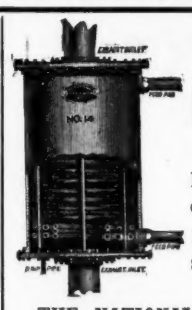


ROOTS' NEW ACME HAND-BLOWERS.
Slow-speeded, Force-blast. Durable, Compact and Cheap.

Roots' Foundry Blowers, Gas Exhausters, etc.

S. S. TOWNSEND, Gen. Agt. } 22 CORTLANDT ST.,
COOKE & CO., Selling Agts., } NEW YORK.

In Writing, Please Mention This Paper.



THE NATIONAL
Feed-Water
HEATER.

A brass coil Heater delivering water to the boiler at 210° Fahrenheit.

100,000 Horse Power sold. Prices Low. Satisfaction universal.

THE NATIONAL PIPE BENDING CO.,
82 River Street, NEW HAVEN, CONN.

JOHN WILEY & SONS, 15 ASTOR PL. NEW YORK.

—PUBLISHERS OF—

SCIENTIFIC AND INDUSTRIAL WORKS.

Send for Catalogues and Circulars.—Free by mail.

WHY THIS IS PUT HERE!

For the reason that if you are interested in raising water or other liquids by steam power, we wish to call your attention to the

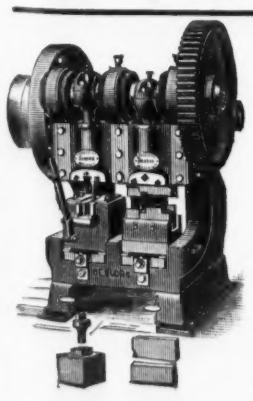
NEW PULSOMETER,

THE CHEAPEST AND BEST STEAM PUMP IN THE MARKET. PRICES LOWER THAN ANY OTHER.

More Efficient, Simple, Durable, and more Economical, both as to running expenses and repairs, than any other Steam Pump.

Call or write for our new 96 page Illustrated Descriptive Book containing Full Particulars, Reduced Net Prices, and hundreds of A-1 Testimonials. Mailed Free.

PULSOMETER STEAM PUMP CO., 120 LIBERTY ST., N. Y.



BEAUDRY'S
DUPLEX
Power Press
COMBINING
PRESS, SHEARS AND PUNCH.

BEAUDRY & CO.
(Formerly of Beaudry's Upright Power Hammer.)
Sole Manufacturers.
Also manufacturers of
HARD COAL HEATING FORGES.
Room 4, MASON B'DG,
70 KILBY ST.,
Boston, Mass.

HENRY CAREY BAIRD & CO.,
Industrial Publishers, Booksellers and Importers,
810 Walnut St., Philadelphia.

☞ Our New and Revised Catalogue of Practical and Scientific Books, 80 pages, 8vo., and our other Catalogues and Circulars, the whole covering every branch of Science applied to the Arts, sent free and free of postage to any one in any part of the world who will furnish his address.

CURTIS & CURTIS,
Successors to FORBES & CURTIS,
66 JOHN ST., Bridgeport Ct., U.S.A.
MANUFACTURERS OF
The Forbes Pat. Die Stock,
Pipe Cutting and Threading Machine, etc.

A portable cutting and threading machine with which one man can with ease thread pipe up to six inch diam. No vise is required.

Send for Illustrated Catalogue.

BOILER EXPLOSIONS and damage from too little and too much water can be obviated, while securing economical results, by using the RELIANCE SAFETY WATER COLUMNS Warranted and sold by Boiler Makers and Dealers generally.

☞ Send for Illustrated Price List.

RELIANCE GAUGE CO.,
27 EUCLID AVENUE,
CLEVELAND, OHIO

One Man can use **Mole's Tire Shrinker.** It is the simplest and most durable **Tire Shrinker** made. Rights for sale. Territory to suit. Patterns furnished. No fancy prices.

Address JOHN G. MOLE, Patentee, Batavia, Ill.

ROSE POLYTECHNIC INSTITUTE,
TERRE HAUTE, IND.—A SCHOOL OF ENGINEERING.

Well endowed, well equipped departments of Mechanical and Civil Engineering, Electricity, Chemistry and Drawing. Extensive Shops and Laboratories. For Catalogue, address

T. C. MENDENHALL, Pres.

C. W. LE COUNT,
South Norwalk, Conn.

REDUCED PRICE OF LE COUNT'S HEAVY STEEL DOG

No.	Inch.	Price
1	3-8	$ .40
2	1-2	.50
3	5-8	.60
4	3 4	.90
5	7-8	.70
6	1	.70
7	1 1-8	.80
8	1 1 4	.80
9	1 3 8	.95
10	1 1 2	.95
11	1 3 4	1.10
12	2	1.20
13	2 1-4	1.35
14	2 1-2	1.45
15	3	1.60
16	3 1-2	1.80
17	4	2.10
18	4 1-2	2.75
19	5	3.25
Full set of 19		$23.00
20 (ext.)	5 1-2	4.00
21 (ext.)	6	5.00

This Dog has a Very Heavy Bow, so that if the thread wears a Heavier Screw can be substituted.

Le Count's Heavy Steel Dog.
With Steel Screws, Lathe Made and Hardened
When ordering, state as above, whether a full set or a set of ½, or small set of 8. Users of these dogs I refer them to any other make.

One Small Set of 8—by 1-4 inches to 20 inch, - - $ 6.25
One Set of 12—by 1-4 in. to 2 in. continued by 1-2 in. to 4 in. 13.25

WHAT USERS THINK OF THE

Hall STEAM PUMP CO., **Steam**

I have been using your pump for about five years, and now have four of them in use and find they give entire satisfaction both in pumping and durability. I have never had to spend a dollar for repairs on any of your pumps since purchasing them. I believe I have the first pump that was manufactured by your Company, and it is doing as good work at the present time as when I bought it.

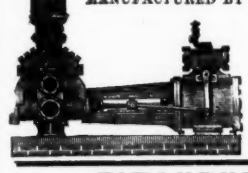
FRANK C. SOMERS, Camden, N. J.

Duplex 91 LIBERTY STREET, NEW YORK. **Pump.**

Dean Bros Steam Pump Works.
Indianapolis, Ind.
Boiler Feeders. Duplex Pumps,
Fire Pumps, Send for Catalogue

THE M. T. DAVIDSON IMPROVED STEAM PUMP

MANUFACTURED BY



DAVIDSON STEAM PUMP COMPANY.

WARRANTED THE **BEST PUMP** MADE FOR ALL SITUATIONS.

PRINCIPAL OFFICE, No. 77 LIBERTY STREET, N. Y.
NEW ENGLAND OFFICE, 51 OLIVER STREET, BOSTON, MASS.

FITCHBURG MACHINE WORKS,
Manufacturers of
Metal-Working Machinery.

OFFICE AND WORKS
NOS. 13 to 21 MAIN STREET,
FITCHBURG, MASS.

SEND FOR CATALOGUE E.

UNION STONE CO., 38 & 40 HAWLEY ST., BOSTON, MASS. 36 JOHN ST., NEW YORK.

Endless Polishing Belt Machine for Removing Scale and Polishing irregular pieces of Work.

SIZES.
1½ in. wide.
2 " "
3 " "
4 " "

Endless Belts of Any Length and Width to order.

Send for Price List.

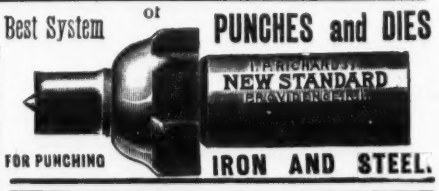
FRICTION CLUTCH PULLEYS AND CUT-OFF COUPLINGS

JAS. HUNTER & SON,
North Adams, Mass.

FRICTION CLUTCH PULLEYS, *Best System* of *HOISTING ENGINES, ELEVATORS, STEAM AND BELT POWER.*

D. FRISBIE & CO., 114 Liberty St., N.Y.

PUNCHES and DIES



FOR PUNCHING IRON AND STEEL.

OUR NEW CATALOGUE OF TOOLS

And Supplies sent free to any address on receipt of Ten Cents in stamps (for postage.)

Chas. A. Strelinger & Co., WOOD AVE., Detroit, Mich.

BEST PLANE IN THE WORLD.

Only Self-Setting Plane

Made by The Gage Tool Co.,

Vineland, N. J.

Fifth order from Widdicomb Furniture Co., Grand Rapids, Mich: "Please ship us 6 more of your No. 2 Self-Setting Smoothing Planes. As soon as we commenced buying these Planes from you, about a year since, we found them almost indispensable, and our men like them very much."

WORTHINGTON PUMPING MACHINERY

HENRY R. WORTHINGTON,

NEW YORK,
BOSTON PHILADELPHIA
CHICAGO ST LOUIS SAN FRANCISCO

SEND FOR Illustrated Catalogue.

Boilers for Export, or for Use in Undeveloped Regions.

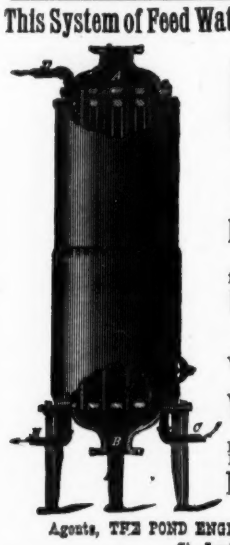
Packed for Transportation on Mule back, in Cases weighing not over 275 lbs.
Easily erected. Self-contained. No brickwork required.
No rivets, expanded joints, calked seams, or packing.

HARRISON SAFETY BOILER WORKS,
GERMANTOWN JUNCTION, PHILADELPHIA, PENNA.

"STEAM" A VALUABLE BOOK for EVERY STEAM USER AND ENGINEER.
PUBLISHED FOR FREE DISTRIBUTION, BY

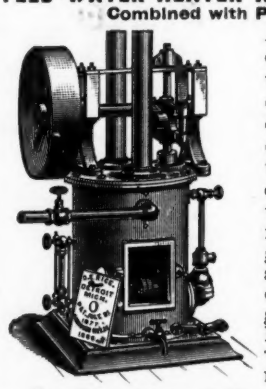
THE BABCOCK & WILCOX COMPANY,
Manufacturers of
WATER-TUBE BOILERS,
107 Hope St., GLASGOW. *30 Cortlandt St., NEW YORK.*

This System of Feed Water Heater is the Best
AND THE



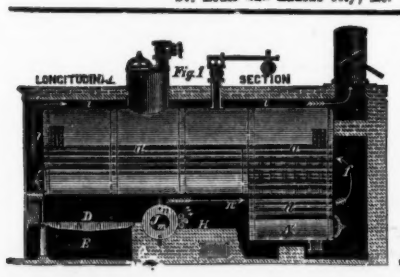
LOWE
is the simplest
HEATER
on the system.
Has Straight Tubes
With reliable provision for expansion, and will
HEAT AND PURIFY THE WATER.
EQUAL TO ANY
With same Feet of Heating Surface and
Wear the Longest
Send for description and Histories of Boilers and Feed Water Heaters, to
Bridgeport Boiler Works.
Bridgeport, Conn.
Agents, THE POND ENGINEERING COMPANY,
St. Louis and Kansas City, Mo.

RICE'S PATENT
FEED-WATER HEATER AND PURIFIER,
Combined with PUMP.



After 10 years' existence is still unequalled for durability, efficiency and economy. Manufacturers should carefully inquire whether their motive power is generated with all possible economy. Investigation costs but little time and will be very remunerative.

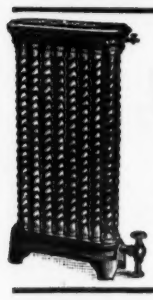
Send for Descriptive Pamphlet.
FRANK M. CLARKSON, Detroit, Mich.
EASTERN AGENT,
WILLIAM H. BAILEY,
5 Dey Street, Room 23, NEW YORK.



The Bate STEAM GENERATOR

Generates steam rapidly and economically. Constant circulation of water. Easily Cleaned. Furnace produces perfect combustion. Best evaporative duty. Material and workmanship A1. Large number in use.

WM. T. BATE & SON,
Sole Manufacturers,
Conshohocken, Penn.



THE WAINWRIGHT
Corrugated Brass Tube Radiator
—FOR—
STEAM OR HOT WATER.
MANUFACTURED BY
THE WAINWRIGHT MAN'F'G COMPANY,
65 and 67 Oliver St., Boston, Mass.
SEND FOR DESCRIPTIVE CIRCULAR.

BEST CHARCOAL IRON STANDARD
Lap-welded BOILER TUBES
SYRACUSE TUBE CO., SYRACUSE, N. Y.

PATENT OILERS, CYLINDER SIGHT FEED CUPS, Government Regulation Pop Safety Valves for Stationary, Marine and Locomotive Boilers,
—Manufactured by—
J. E. LONERGAN & CO., Brass Founders & Finishers,
211 RACE ST., PHILADELPHIA, PA.

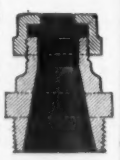
FOR
SUBSTANTIAL, WELL MADE, LOW PRICED
20 INCH DRILLS,
With latest improvements, Lever or Wheel feed, address
Sibley & Ware,
SOUTH BEND - - INDIANA.

MACHINIST'S SCALES,
PATENT END GRADUATION.
We Invite Comparison for Accuracy with all others.
EVERY SCALE GUARANTEED. SEND FOR LIST.
COFFIN & LEIGHTON, SYRACUSE, N. Y.

BAILEY'S PATENT COPPER CAP FUSIBLE PLUG.
A Cheap Means for Preventing Accidents to Steam Boilers through Low Water.

The **fusible metal is kept from contact with the water,** thereby avoiding the chemical and mechanical action, which would otherwise prevent it from melting. Cap is readily removable, permitting free inspection.

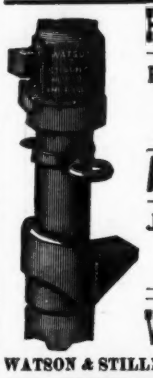
Highly recommended by the chief Boiler Insurance Companies of Great Britain. Over 150,000 sold in Europe since first introduced, with increasing sales. Highly recommended also by the U. S. Board of Supervising Inspectors of Vessels at Washington, D. C; by Prof. R. H. Thurston, and many other eminent expert engineers, as superior to any now in use, and filling all requirements. Highly recommended also by a number of master mechanics.



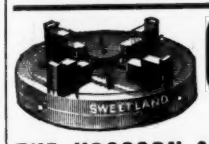
GEO. VAN WAGENEN, Sole American Licensee and Manufacturer.
Illustrated Pamphlets on Application. 233 West Street, New York City.

WESTCOTT CHUCK CO., Formerly Oneida Steam Engine & Foundry Co., **ONEIDA, N.Y.**
Manufacturers of all kinds of
LATHE AND DRILL
CHUCKS.
Send for Catalogue.
Under Westcott's Patent.

Capacity Little Giant Improved.		
No. 00	holds 0 to	1/4 inch.
" 0	" 0 to	3/8 "
" 1	" 0 to	5/8 "
" 2	" 0 to	1 "
" 2½	" 0 to	1 "



HYDROSTATIC MACHINERY,
PRESSES,
PUMPS,
PUNCHES,
ACCUMULATORS,
JACKS,
VALVES,
FITTINGS,
VAULT ELEVATORS, &c., &c.
WATSON & STILLMAN, 204-210 East 43d St., N. Y.



CHUCKS
Manufactured by
THE HOGGSON & PETTIS MFG. CO.,
Est. 1849. NEW HAVEN, CT.

1884 PATENT CHUCKS.

We make a specialty of geared scroll chucks in diam's below 12". For many uses a scroll chuck cannot be excelled. Ask at your dealers for our 1884 Patent or write for our catalogue.

THE D. E. WHITON MACHINE CO.,
New London, Conn.

WELDLESS STEEL QUICK OPENING GATE VALVE. COLD DRAWN TUBES
SMOOTH INSIDE & OUT.
JOHN S. LENG, 4 Fletcher St. N.Y.

SEND 6 CENTS for our NEW CATALOGUE of Fine Tools. Agents wanted in shops west of Philadelphia.
E. H. RANDALL & CO.,
154 Lake Street, - - Chicago.

DELAFIELD'S PAT. SAW CLAMP

With Saw for Cutting Metals. Saves all the broken hack-saw blades. In use over two years in all parts of the country. The new Clamps have the edges beveled that hold the saw. Free by mail for 50 cents. Extra blades, 1-2 in. wide, 7c. each, 70c. per dozen; 1 in. wide, Stubs, 35c. each. Free by mail.
NOROTON MFG. WORKS, NOROTON, CONN.

ESTABLISHED 1853.
HOWSON & HOWSON
Counsellors at Law Solicitors of Patents
Philadelphia Offices: 119 South Fourth Street
New York: Potter Building, 38 Park Row
Washington, D.C.: 915 F. Street

Sterling Emery Wheel Co.,
Factory, West Sterling, Mass.
Office, 17 Dey Street, New York.
Our Wheels for Machine Shop Work and Tool Grinding Superior to all others.
Send for Catalogue just published.

TRADE MARK.
THE HORTON LATHE CHUCK!

Manufactured by
THE E. HORTON & SON CO.,
Windsor Locks, Conn., U. S. A.
Send for Illustrated Catalogue.

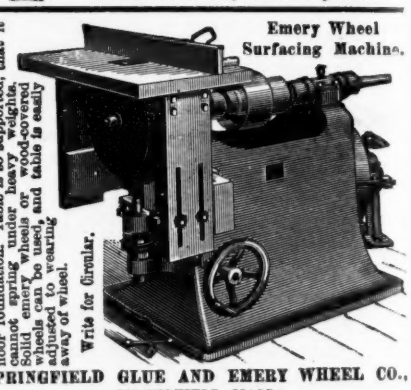
"CUSHMAN" CHUCKS

Are guaranteed to be right in all respects. Ask to see them at your dealer's, or write direct to the factory. Respectfully,

THE CUSHMAN CHUCK CO.,
HARTFORD, CONN.

A Complete Cutting-off Machine, $4.00.
Larger ones which cut to 2 in. $8.00.
S. ELLIOTT, Newton, Mass.

Emery Wheel Surfacing Machine.

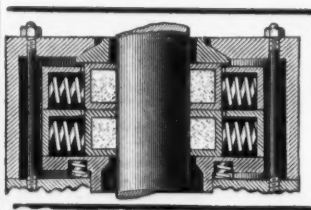


Base of machine has sufficient mass to give solid floor foundation. Table is so supported, that it cannot spring under heavy weight. Solid emery wheels or wheels covered with leather can be used, and table is easily adjusted to wearing away of wheel. Write for Circular.

SPRINGFIELD GLUE AND EMERY WHEEL CO.,
SPRINGFIELD, MASS.

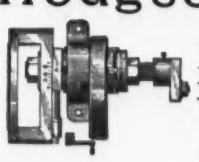
ELECTRIC LEATHER BELTING.
ELECTRIC LEATHER BELTING.
WIRE SCREWED.
RUNS SMOOTH AND EVENLY.
SPECIALLY ADAPTED FOR
Dynamos and Swift Running Machinery.
CHAS. A. SCHIEREN & CO.,
(Manufacturers,)
19 FERRY STREET, *NEW YORK.*

TRUMP CHUCK.
The Best and Cheapest Chuck made. Will hold STRAIGHT or TAPER Shank Drills ACCURATELY.
3 sizes: 1/8", 1/4" and 5/16".
Write for Prices to
TRUMP BROS. MACHINE CO.,
WILMINGTON, DELAWARE.



ANDREW GRAY, Pres. W. H. Hollis, Treas. E. P. MONROE, Gen'l Manager.
U. S. METALLIC PACKING CO.,
Philadelphia, Pa.
OFFICE, 133 S. 4th St. WORKS, 435 N. Broad St.
20,000 Packings in use on Locomotives, Stationary and Marine Engines.

Hodgson's Eccentric Mandrel.



DESIGNED FOR QUICKLY AND CHEAPLY TURNING UP LOCOMOTIVE ECCENTRICS AND OTHER ECCENTRIC WORK OF A SIMILAR KIND. IT IS EASILY SET AND WILL BE FOUND VERY CONVENIENT.

PEDRICK & AYER,
1025 HAMILTON STREET, - - PHILADELPHIA, PA.

MORSE TWIST DRILL AND MACHINE COMPANY, New Bedford, Mass.

Manufacturers of **Morse Patent Straight-Lip Increase Twist Drills.**

Solid and Shell Reamers, Beach's Patent Self-Centering Chuck, Bit Stock Drills.
DRILL GRINDING MACHINES, MILLING CUTTERS AND SPECIAL TOOLS TO ORDER.

DRILLING MACHINES.

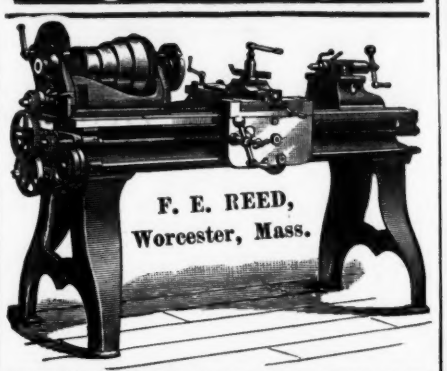
ALL STYLES WITH
Latest Designs and Improvements.
For cuts and prices address,
BICKFORD DRILL CO.,
Front & Pike Sts., Cincinnati, O.

COMPLETE STEAM PUMP ONLY SEVEN DOLLARS
DEMAND THIS PUMP OF YOUR DEALER OR WRITE TO US FOR PRICES.
VAN DUZEN'S PATENT
VAN DUZEN & TIFT.
SOLE MAKERS
CINCINNATI, O.

WILLIAM BARKER & CO.,

Send for circulars and prices.

Manufacturers of
Iron and Brass Working
MACHINERY
140 & 142 E. Sixth St., Near Culvert,
CINCINNATI, O.



F. E. REED, Worcester, Mass.

ENGINE Lathes, Hand Lathes, Foot Lathes, Upright Drills, and Milling Machines. Agents, MANNING, MAXWELL & MOORE, 111 LIBERTY STREET, NEW YORK.

SEND FOR CATALOGUE.
WORCESTER MACHINE SCREW CO.

Manufacturers of Set, Cap and Machine Screws, Studs, etc.

PATENT UNIVERSAL SCREW-CUTTING CENTER DEPTH ANGLE AND
J. WYKE & CO., TWIST DRILL GAUGE.
Fine Machinists' Tools.—E. Boston, Mass—Send for Circular.

We are making a specialty of
14 Inch ENGINE LATHES;
And are selling them at such very low prices that even the Poverty-Stricken can afford to buy them.
Don't sleep another night until you write us for Phototypes and Prices. **S. Ashton Hand Mfg. Co.,**
Toughkenamon, Pa.

WOOD-WORKING MACHINERY

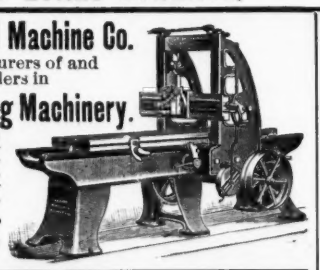
For Planing Mills, Furniture, Chair and Cabinet Factories, Cabinet Works and General Wood Working. Send Stamp for Illustrated Catalogue to
Rollstone Machine Co
45 WATER ST.,
Fitchburg, Mass

HUGO BILGRAM,
440 N. 12th St., Phila. Pa.
Maker of all kinds of
MACHINERY.
Special facilities for Accurate Work.
Bevel Gears cut theoretically Correct.

UPRIGHT DRILLS
SIZES 20-23-25-28-32-36
WE MAKE THE BEST
CURRIER & SNYDER
WE DO NICE WORK. WORCESTER, MASS

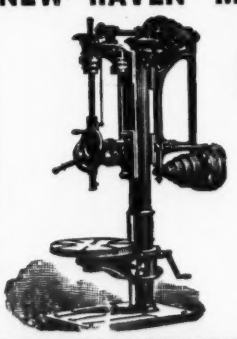
SEND FOR PHOTO OF OUR NEW AND IMPROVED
17 inch ENGINE LATHE,
COMPOUND REST AND TAPER ATTACHMENT.
HIGHEST GRADE OF WORKMANSHIP.
THE MULLER MACHINE TOOL CO.,
8TH and EVANS STREETS, CINCINNATI, OHIO.

L. W. Pond Machine Co.



Manufacturers of and Dealers in
Iron Working Machinery.
Improved Iron Planers a specialty. Feed, patented Feb. 9, 1886. Belt Shifter, patented Nov. 2, 1886.
140 Union St., Worcester, Mass.

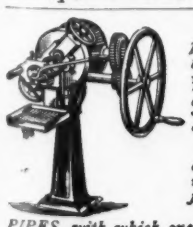
NEW HAVEN MANUF'G CO.



New Haven, Conn
Lathes, Planers, Shapers, Slotters, Etc.

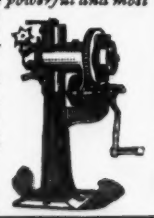
L. S. STARRETT,
Manufacturer of
FINE TOOLS,
ATHOL, MASS.
SEND FOR FULL LIST

"Eclipse" Hand Pipe-Cutting Machines.



No. 1.—Powerful, inexpensive, simple in construction. Cuts and screws pipes ⅛ to 2-inch. Easily carried about.

"ECLIPSE" Nos. 2 and 3. These are powerful and most efficient machines for cutting large PIPES, with which one man can easily cut off and thread 6-inch pipe.
No. 2 Cuts and Screws 2½ to 4 in.
No. 3 " " " 2½ to 6 in.
It will pay you to write us for particulars.
PANCOAST & MAULE,
(Mention this paper.) Philadelphia.
We also build Power Machines.

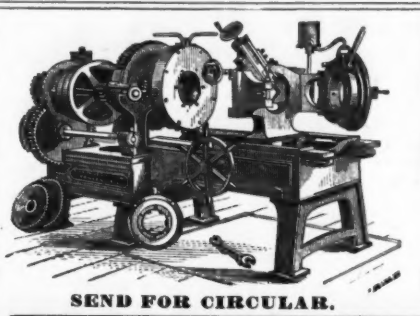


CARY & MOEN
STEEL WIRE OF EVERY DESCRIPTION
STEEL SPRINGS NEWYORK CITY

DIXON'S INDIA SILVER LEAD

Joseph Dixon Crucible Co.
JERSEY CITY, N. J.

THE
Powell Planer Co.
Manfrs. IRON PLANERS,
Worcester, Mass.



SEND FOR CIRCULAR.

D. SAUNDERS' SONS,
Manufacturers of
Pipe Cutting & Threading Machines
For Pipe, Mill and Steam Fitters' Use.
TAPPING MACHINES,
For Steam Fitting, also
Steam and Gas Fitters' Hand Tools.
YONKERS, N. Y.

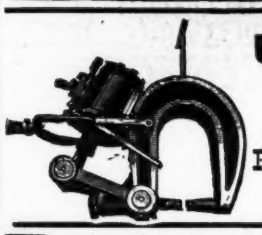
MACHINERY
For Reducing & Pointing Wire
ESPECIALLY ADAPTED TO POINTING WIRE RODS AND WIRE FOR DRAWING
For Machines or information, address the manufacturer,
S. W. GOODYEAR, Waterbury, Ct.

CHARLES MURRAY
ENGRAVER ON WOOD
58 ANN ST. NEW YORK.

THOS. H. DALLETT & CO.
1305 Buttonwood Street,
PHILADELPHIA, PA.
Portable Drills,
Hand Drills,
Boiler Shell Drills,
Light Drill Presses,
Special Machinery.
SEND FOR CATALOGUE.

BUFFALO FORGES

BLOWERS, EXHAUSTERS, HEATING FURNACES.
HAND BLOWERS, BLACKSMITH DRILLS.
BUFFALO FORGE CO.
BUFFALO, N.Y.



U. BAIRD MACHINERY CO.
Pittsburgh, Pa.
MACHINISTS' TOOLS AND SUPPLIES.
Pattern Makers' Tools. Boiler Makers' Tools.
STURTEVANT BLOWERS AND EXHAUST FANS.

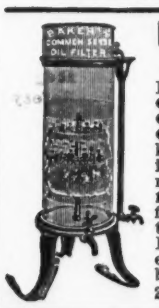
RAILROAD FROG PLANER
BUILT BY
The G. A. Gray Co.
CINCINNATI, O.

Photographs sent on Application.

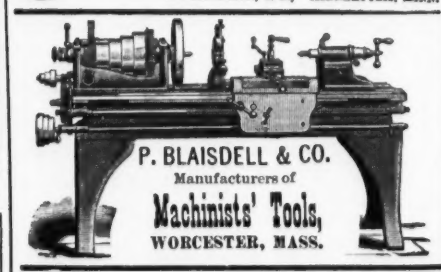
McMAHON & COMPANY,
MANUFACTURERS OF

Machinists' Tools,
AND
Patent Friction Pulleys.
Water St., Corner Ledge,
WORCESTER. - - MASS.

W. C. YOUNG & CO., Worcester, Mass.
Manufacturers of
Engine Lathes, Hand Lathes,
Foot Power Lathes, Slide Rests, Etc.



BAKER'S COMMON SENSE OIL FILTER.
Is the most **Simple, Neat, Ornamental, Effective, Complete** and **Convenient OIL FILTER** in the Market. The whole **operation** is **visible,** and any ordinary man can operate it **successfully.** It will pay for itself the first year, if a little pains is taken to catch the waste oil from your Engine, Dynamo, Shafting, etc., etc. Manufactured and for sale by **CHAS. F. BAKER,**
223 Third Ave., S. E., MINNEAPOLIS, MINN.



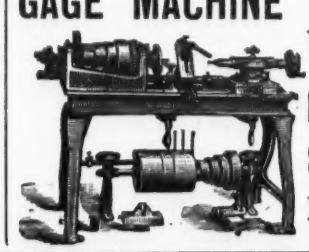
P. BLAISDELL & CO.
Manufacturers of
Machinists' Tools,
WORCESTER, MASS.

SHAPING MACHINES
FOR HAND AND POWER.
6", 8" and 10" Stroke.
Adapted to All Classes of Work to their Capacity.
Circulars Furnished.
BOYNTON & PLUMMER,
WORCESTER, MASS.

Friction Driven Center Grinder.
A neat, simple and cheap tool to true up centers, will grind centers up quicker than they can be annealed, turned and hardened, will go on any size lathe without any adjustment.
Send for descriptive circular.
ENERGY M'F'G CO.
1115 to 1123 S. 15th Street,
PHILADELPHIA, PA.

MACHINE TOOLS.
Special or General, any size, for the manufacture of Ordinance, Locomotive, Marine and Stationary Engines, Ships' Boilers, &c., supplied to many leading Firms in the United States of America.
Asquith's Patent Radial Drills
Unequaled by any in the World. Send specification of requirements. Large Stock of Tools ready for delivery.
W. ASQUITH, HALIFAX, England.

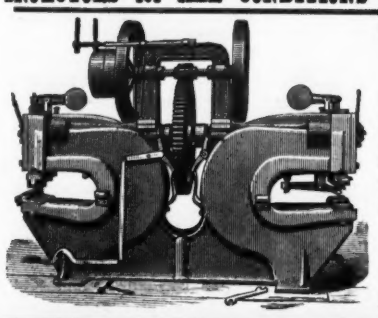
GAGE MACHINE WORKS,
Waterford, N.Y.



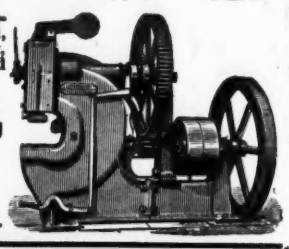
Manuf'r's of
FOX, TURRET AND **Speed Lathes** AND
Brass Finishers' TOOLS.

250 Used by one Firm
IN LESS THAN A YEAR IS THE RECORD MADE BY THE MASON REDUCING VALVE.
MASON REGULATOR CO., BOSTON

WILLIAM SELLERS & CO., Incorporated.
PHILADELPHIA, PA.
BUILDERS OF
MACHINE TOOLS FOR WORKING IRON AND STEEL.
Improved TURNTABLES for LOCOMOTIVES, CARS and PIVOT BRIDGES.
High Speed Power Traveling Cranes and Hand or Power Swing Cranes, Shafting, Pulleys, Hangers, &c., for transmission of power. Improved Self-Adjusting Injector of 1876. Self-Acting Injector of 1887. Fixed-Nozzle Automatic Injector of 1885.
INJECTORS for ALL CONDITIONS of LOCOMOTIVE and STATIONARY SERVICE



THE LONG & ALLSTATTER CO. Hamilton, OHIO.
Double, Single, Angle-Bar, Gang, Horizontal, Twin, Boiler, Spacing, Gate, Multiple, Belt and Steam-Driven
Punches and Shears,
Over 300 Sizes.
ALSO
Power Cushioned Hammer.
Send for New Catalogue.

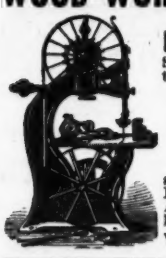


All GENUINE INGOTS & MANUFACTURES BEAR OUR REG. TRADE MARKS.
"Phosphor-Bronze."
PHOSPHOR-BRONZE
INGOTS, CASTINGS & MANUFACTURES.
THE PHOSPHOR BRONZE SMELTING CO. LIMITED
512 ARCH ST. PHILADELPHIA PA. U.S.A.
ORIGINAL MANUFACTURERS OF PHOSPHOR-BRONZE IN THE UNITED STATES AND OWNERS OF THE U.S. PATENTS.

THE BECKETT & McDOWELL MFG. CO.
ARLINGTON, N. J. S. A. BECKETT, GEN'L MANAGER.
IRON FOUNDERS AND MACHINISTS.
MANUFACTURERS OF
Steam Engines and General Machinery. Specialties: Ore-Crushing Machinery, Stamp Mills and Mining Hoists.
Having Extensive Foundry Capacity, we are prepared to contract for regular supply of Machinery Castings.

PURE CARBON BRONZE.
Heavy Journal Bearings our Specialty.
Specially adapted for use on Steam Engines, Heavy Machinery, Locomotives, &c.
Look for brand, "Pure Carbon Bronze."
CARBON BRONZE CO.,
SOLE MANUFACTURERS,
38 WATER ST., PITTSBURGH, PA.

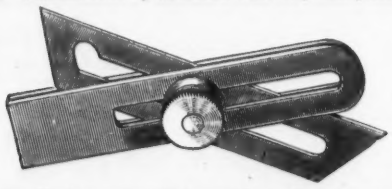
J. A. FAY & CO. CINCINNATI, OHIO, U.S.A.
BUILDERS OF IMPROVED
WOOD-WORKING MACHINERY
Embraces nearly 400 Machines for
PLANING & MATCHING
Surfacing, Moulding, Tenoning, Mortising, Boring, and Shaping, etc.
Variety and Universal
WOOD WORKERS.
Band, Scroll and Circular Saws, Resawing Machines, Spoke and Wheel Machinery, Shafting, Pulleys, etc. All of the highest standard of excellence.
W. H. DOANE, Pres. D. L. LYON, Sec'y



COPELAND
OIL-BURNING STEAM ENGINE.

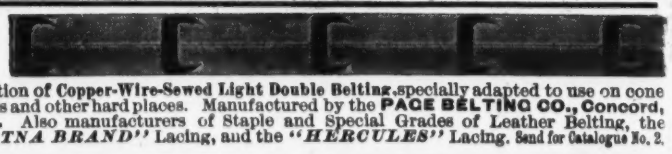
Water, Steam, Fire. Entirely and reliably
AUTOMATIC.
No Engineer required. Consumes about one-third as much oil as other oil-burning engines. Weight of 2 H. P. engine, 100 pounds.
GENERAL AGENTS:
Penna.: KIRK BROWN, 18 S. Broad Street, Phila.
Chicago: COPELAND S. E. CO., 199 S. Clark St.
St. Louis: M. M. BUCK & CO.
NORTHROP MFG. CO.,
117-121 N. Front St., Camden, N. J.

SEND for Illustrated Price List of *Fine Tools*, manufactured by Standard Tool Co., Athol, Mass.

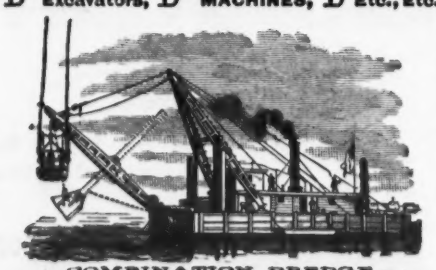


Any Tool we make will be sent by mail or express to any address, all charges prepaid, on receipt of price.

SHEPARD'S NEW $60 SCREW-CUTTING FOOT LATHE.
Foot and Power Lathes, Drill Presses, Scroll-saw Attachments, Chucks, Mandrels, Twist Drills, Dogs, Calipers, etc.
Lathes on trial. Lathes on payment.
Send for catalogue of Outfits for Amateurs or Artisans.
Address, H. L. SHEPARD, Agent, 134 E. Second St., Cincinnati, O.

THE HERCULES TRADE MARK BELT JOINT PATENTED

Section of Copper-Wire-Sewed Light Double Belting, specially adapted to use on cone pulleys and other hard places. Manufactured by the PAGE BELTING CO., Concord, N. H. Also manufacturers of Staple and Special Grades of Leather Belting, the "PATNA BRAND" Lacing, and the "HERCULES" Lacing. Send for Catalogue No. 2.

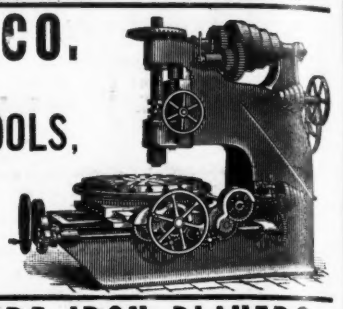
OSGOOD DREDGE CO., - ALBANY, N. Y.
RALPH R. OSGOOD, Pres. JAMES H. BLESSING, Vice-Pres.
JOHN K. HOWE, Secretary and Treasurer.
Manufacturers of
DREDGES, Excavators, DITCHING MACHINES, DERRICKS, Etc., Etc.

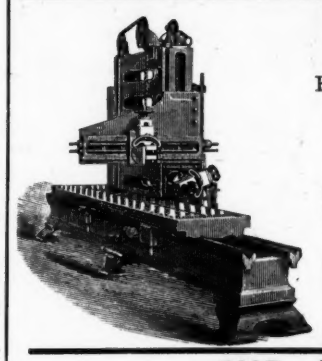

—COMBINATION DREDGE.—

MACHINE TOOLS
For Immediate Delivery.
1 42 in. x 18 ft. bed, treble-geared **LATHE.**
1 32 in. x 18 ft. bed, treble-geared "
1 36 in. x 36 in. x 9 ft. stroke **PLANER.**
1 40 in. x 36 in. x 12 ft. stroke **PLANER.**
1 48 x 48 x 22 ft. stroke **PLANER.**
These planers are held at very low prices.
1 72 in. Pulley **TURNING MACHINE.**
1 72 in. " **BORING MACHINE.**
1 13 in. **SLOTTER.**
1 42 in. Cam Milling Machine for Printing Press Cam.
THE NEWARK MACHINE TOOL WORKS,
Newark, N. J.

Southwark Foundry and Machine Company,
Engineers, Machinists and Boiler Makers,
WASHINGTON AVENUE AND FIFTH ST., - PHILADELPHIA.
—SOLE MAKERS OF—
PORTER-ALLEN AUTOMATIC ENGINE.
—ALSO MANUFACTURERS OF—
BLOWING ENGINES, REVERSING ENGINES, STEEL AND HYDRAULIC MACHINERY, BOILERS, TANKS, ETC.
Steam Hammers, Centrifugal Pumps, Rolling Mill Works.
INQUIRIES SOLICITED.

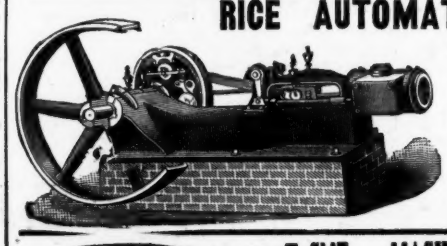
BEMENT, MILES & CO.
PHILADELPHIA, PA.
BUILDERS OF
METAL-WORKING MACHINE TOOLS,
FOR
RAILROAD SHOPS, LOCOMOTIVE AND CAR BUILDERS, MACHINE SHOPS, ROLLING MILLS, STEAM FORGES, SHIP YARDS, BOILER SHOPS, BRIDGE WORKS, ETC.



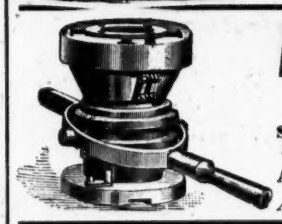


THE OPEN-SIDE IRON PLANERS.
For Accuracy and Dispatch in the performance of the regular line of planer work, these tools are guaranteed to be unexcelled by the ordinary style of planers of the very best makes.
For a large class of the Extra Wide and Heavy Work, requiring the Large and Costly Planers of the regular type, the Open-Side Planers are invaluable.
The Sellers Spiral Planer Motion is employed on these planers.
DETRICK & HARVEY, Manufacturers,
Price, phototypes, etc., on application. BALTIMORE, MD.

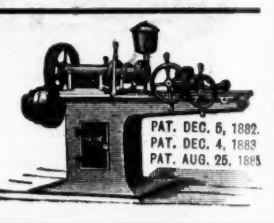
RICE AUTOMATIC CUT-OFF ENGINE.

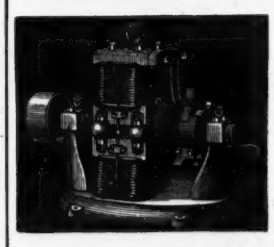


Self-Contained. Sensitive Governor. Balanced Valve. High Speed. Stationary Oilers. Best Economy
Gold Medal Cincinnati Exposition, 1884.
THE JOHN T. NOYE MFG. CO.,
BUFFALO, N. Y.



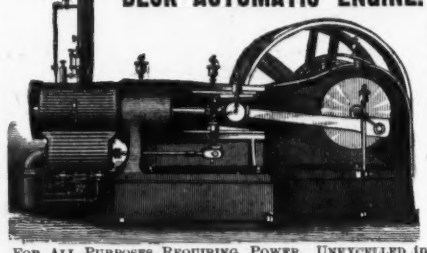
ACME MACHINERY CO.,
CLEVELAND, OHIO.
Manufacturers of
"ACME"
Single & Double Automatic Boltcutters,
Cutting from 3-8 in. to 6 in. diameter.
Also Separate Heads and Dies.
Send for Catalogues and Discounts.
Agents, Manning, Maxwell & Moore, New York.





WHAT THEY SAY.
SPRINGFIELD, OHIO, April 9th, 1888.
THE WATERHOUSE ELECTRIC AND M'F'G CO., Hartford Conn.
Gentlemen:—Replying to your favor of the 5th instant, would say that the machine and lamps you furnished us for Electric Lighting are giving the very best of satisfaction. We are well pleased with them.
Very truly yours,
THE WARDER BUSHNELL & GLESSNER CO.
CHAS. A. BAUER, General Manager.
GOLD MEDAL AWARDED, MECHANICS' FAIR, BOSTON, DEC., 1887.
For the best system of Electric Lighting in the World, address
THE WATERHOUSE ELECTRIC & MANUFACTURING CO.,
HARTFORD, CONN.

BECK AUTOMATIC ENGINE.

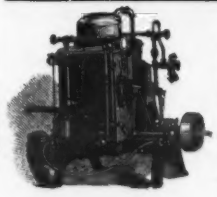


FOR ALL PURPOSES REQUIRING POWER. UNEXCELLED in Economy, Regulation, Coolness of Bearings, Workmanship, and General Efficiency.
ESPECIALLY ADAPTED FOR ELECTRIC LIGHTING.
Complete Steam Plants a Specialty. Satisfaction Guaranteed.
Write for catalogue to
TAYLOR MFG. CO., Chambersburg, Pa., U. S. A.

KORTING GAS ENGINE.
1 to 100 Horse Power.

The Korting Gas Engine is placed upon its merits and under full guarantee to every purchaser.
CATALOGUES on APPLICATION.
KORTING GAS ENGINE CO., LIMITED.
60 BARCLAY STREET, NEW YORK.

FLUOR SPAR THE BEST *Foundry* **FLUX.**
SEND FOR LIST OF USERS.
Evansville Spar Mining Co., Evansville, Ind.

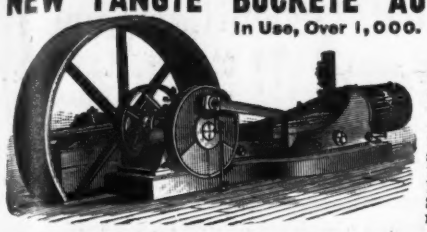


OIL ENGINES.
For Printers, Steam Yachts, pumping water, sawing wood, making ice-cream, Carpenters, Mechanics. 1 to 5 H.P. Fuel, Kerosene. No dust. Automatic in fuel and water supply. Illustrated Catalogue free. Mention AMERICAN MACHINIST.
SHIPMAN ENGINE CO.,
92 Pearl St., Boston, Mass.

NEW TANGYE BUCKEYE AUTOMATIC CUT-OFF ENGINES.

In Use, Over 1,000.

25 to 1,000 H.P.



These engines are the combined result of long experience with automatic cut-off regulation, and most careful revision of all details. They are designed and constructed for heavy and continuous duty at medium or high rotative speeds. Highest attainable Economy in Steam Consumption and superior regulation guaranteed. Self-contained Automatic Cut-off Engines 12 to 100 H P. for driving Dynamo Machines *a specialty*. Illustrated Circulars, with various data as to practical Steam Engine Construction and performance, free by mail. Address, BUCKEYE ENGINE CO., Salem, Ohio.

SALES AGENTS: W. L. SIMPSON, 301 TELEPHONE BUILDING, 18 CORTLANDT STREET, N. Y. | N. W. ROBINSON, 154 Washington St., Chicago, Ill. ROBINSON & CARY, St. Paul, Minn.

KENSINGTON ENGINE WORKS, LIMITED, PHILADELPHIA.

Sole Licensees and Manufacturers for New Jersey (South of Trenton), Eastern Pennsylvania, Delaware, Maryland and Virginia.

THE ALBANY STEAM TRAP CO.'S

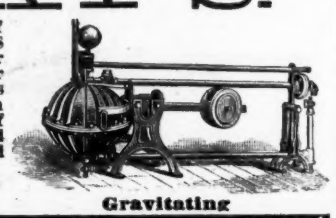
BUCKET AND GRAVITATING

TRAPS.

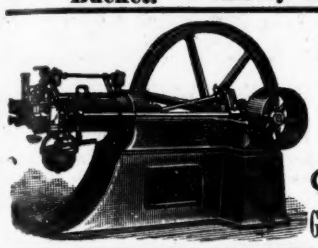
Bucket.

Automatically drain the water of condensation from HEATING COILS and return it to the boilers, whether the coils are above or below the water level in boiler, doing away with pumps and other mechanical devices for such purposes. Send also for Circulars of Blessing's Renewable-Seat Stop and Check Valves, Pump Governors, and Water Circulator and Purifier.

Albany Steam Trap Co. Albany N. Y.



Gravitating



"OTTO" GAS ENGINE WORKS.

SCHLEICHER, SCHUMM & CO.,

33d and Walnut Sts. PHILADELPHIA.

Branch Office, 130 Washington St. CHICAGO.

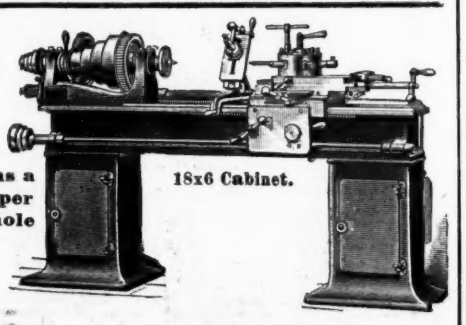
OVER 25,000 ENGINES IN USE.

GUARANTEED To Consume 25 to 75 Per Cent. Less Gas than ANY Other Gas Engine doing the same work.

LODGE, DAVIS & CO.

CINCINNATI, OHIO.

☞ 17" Engine Lathes for tool rooms a specialty. Every lathe complete with taper attachment. Compound rest, 1 5-16" hole in spindle, etc.



18x6 Cabinet.

15x6 Fox Monitor.

MANUFACTURERS OF

CABINET TURRET, FOX MONITOR, SQUARE ARBOR, TURRET CHUCKING, and HAND FOX LATHES.

VALVE MILLERS, COCK GRINDERS

SLIDE RESTS, ETC.

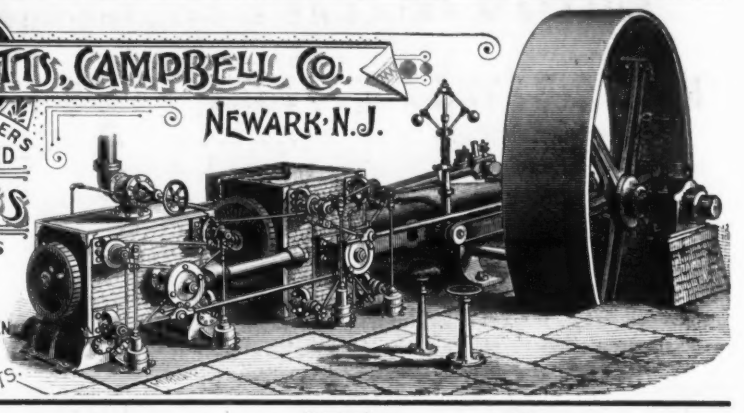
☞ See special adv't page 16.

THE WATTS, CAMPBELL CO.

MANUFACTURERS OF IMPROVED CORLISS STEAM ENGINES IN FULL VARIETY.

NEWARK, N.J.

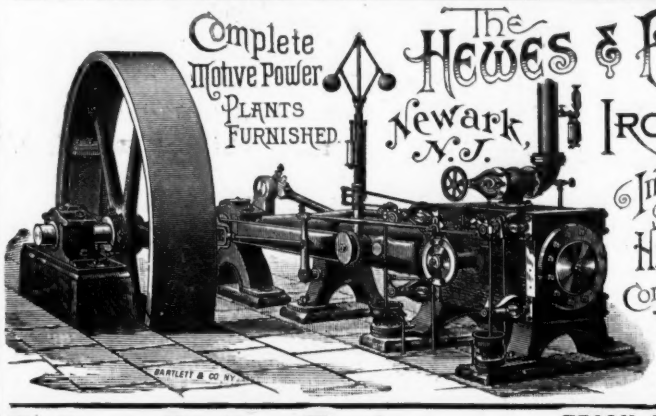
CONTRACTS TAKEN FOR COMPLETE POWER PLANTS.



The HEWES & PHILLIPS IRON WORKS

Complete Motive Power Plants Furnished.

Newark, N.J.



Improved CORLISS ENGINES. High Pressure. Condensing and Compound TUBULAR BOILERS.

GEO. A. BARNARD AGENT.

Eclipse Corliss Engine.

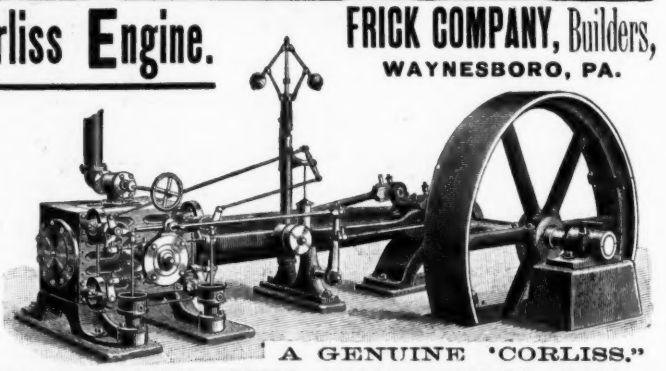
FRICK COMPANY, Builders, WAYNESBORO, PA.

Non-Condensing, Condensing, Compound.

40 TO 1,000 H.P.

Send for Circulars.

E. P. HAMPSON & CO., 36 CORTLANDT ST., NEW YORK, Sole Eastern Agents.



A GENUINE "CORLISS."

M. J. TIERNEY, 20 NORTH CANAL STREET, CHICAGO, WESTERN AGENT.

ROBERT WHITEHILL,

NEWBURGH, N.Y.

MANUFACTURER OF IMPROVED CORLISS ENGINES

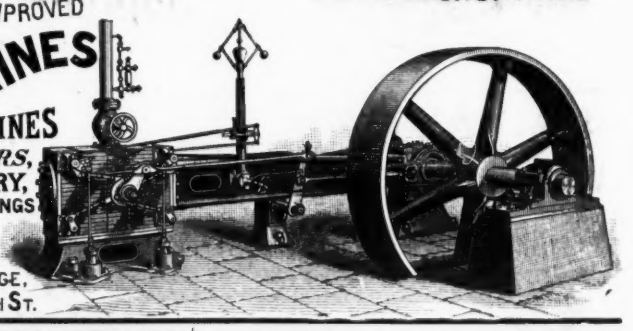
ALSO SLIDE VALVE ENGINES

STATIONARY BOILERS,

GENERAL MACHINERY,

IRON AND BRASS CASTINGS

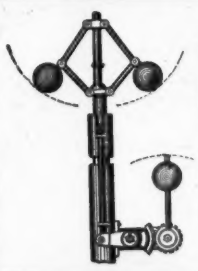
NEW YORK OFFICE Room 6, COAL AND IRON EXCHANGE, Cor. CORTLANDT & CHURCH ST.



THE PORTER-HAMILTON,

The Best Engine in America for Heavy Work.

WILLIAM TOD & CO., Youngstown, Ohio.



WILSON'S SPEED CONTROLLER,

As attached to the Governor of a Corliss Engine, made only by

Remington Machine Co.,

BUILDERS OF CORLISS ENGINES, BOILER MAKERS AND BRASS FOUNDERS.

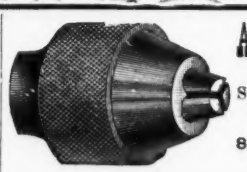
Wilmington, Del.

PECK'S PAT. DROP PRESS.

BEECHER & PECK. NEW HAVEN CONN.

DROP FORGINGS OF IRON OR STEEL

BEECHER & PECK. NEW HAVEN CONN.



Almond Drill Chuck,

Sold at all Machinists' Supply Stores.

T. R. ALMOND, 83 & 85 Washington St., Brooklyn, N. Y.

MACHINERY ON HAND.

16in.x42 in.	Planer.	Bridgeport,	new.
20 in x4 ft.	"	New Haven,	fair.
22 in.x4 ft	"	Ames,	good.
22 in.x4-5 and 6 ft.	"	Powell,	new
24 in.x6 ft.	"	Powell,	"
26 in.x7 ft.	"	Brettel,	"
27 in.x4 ft.	"	Windsor,	cheap
30 in.x8 ft.	" each	Atherton, Powell & H. & P.	new.
36 in.x12 ft.	"	Niles,	good.
38 in.x14 ft.	"	Enterprise,	cheap.
60 in.x12 ft.	"	G. W. & W. Screw,	good.
64 inx.12 ft.	"	Bement,	fair.
11 in.x4 ft.	Engine Lathe,	Prentise,	good.
12 in. x6 ft	"	Young,	new.
13 in.x6 ft.	"	Ames,	"
14 in.x6 ft.	"	Blaisdell,	"
14 in.x7 ft.	"	Bogart,	"
14 in.x6 ft	" Gap Bed,	S. M. & Co.,	"
15 in.x6 and 8 ft.	"	Porter,	"
16 in x6 ft.	"	Ames,	A 1.
16 in.x6 and 8 ft.	"	Blaisdell,	new.
16-20 in.x6-8-10 & 12 ft.	"	Bridgeport,	"
18 in.x8-10-12 ft.	"	Different Makes,	"
20 in.x8-10-14ft.	"	Different Makes,	"
20 in. any length Bed	"	Bridgeport,	"
22 in.x12 ft.	"	Niles,	heavy.
23 in.x8-10 12 & 14 1-2	"	Bridgeport,	new.
26 in x12 ft.	"	Wright,	new.
28 in.x16 ft.	"	Fifield,	"
36 in.x14 ft.	"	Fifield,	"
42 in.x24 ft.	"	D. W. Pond,	A 1.
20 in. Drill		Davis,	new.
20-23-25-28 inch Drills		Blaisdell,	"
20-25-28-32 inch	"	C. & S.	"
36 in. Drill		Gould,	cheap.
5 ft. Am. Universal Radial Drill,			new.
No. 1 and 3 Universal Miller, Brown & Sharpe,			"
No. 1-2 and 6 Plain	"	" " "	"
No. 1 and 2 Universal Grinder,	"	"	"

Cold Rolled Shafting in Stock. Send for list. Write for what is wanted.

E. P. BULLARD,

62 College Place & 72 Warren St., New York.

UNIVERSAL RADIAL RADIAL DRILLING MACHINES

THREE DESIGNS. SIX SIZES. EMBODY ALL DESIRABLE FEATURES

PRICES $450.00 & UPWARD

DIETZ UNIVERSAL RADIAL DRILL CO. CINCINNATI, O. U.S.A.

EAGLE ANVIL WORKS,

Trenton, N. J.

The Fisher Double Screw Leg Vise.—Warranted stronger grip than any other Vise. Always parallel and cannot be broken.

Send for Circulars.

The Eagle Anvil.—Best Cast Steel Face & Steel Horn. Better than any English anvil. Fully warranted and lower price.

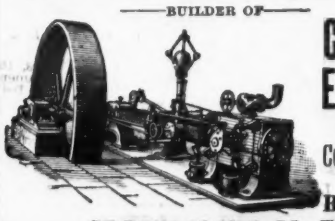
ECONOMICAL STEAM BOILERS

A SPECIALTY.

SEND FOR PRICES. Pond Engineering Co. ST. LOUIS, MO.

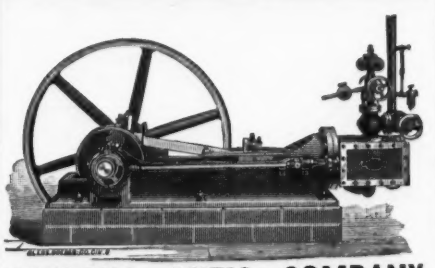
JOHN McLAREN,

BUILDER OF



CORLISS Engines, AIR Compressors and BOILERS.

HOBOKEN, N. J.



STEARNS M'F'G COMPANY,

ERIE, PA.

ENGINES from 15 to 400 Horse Power.

Boilers of Steel and Iron supplied to the trade or the user. Send for Catalogues.

SAW MILLS and GENERAL MACHINERY.

Works at Erie, Pa.

New York Store, 46 Cortlandt Street,

SMITH & BARNHURST, Manager.

HILL, CLARKE & CO.

List of Second-Hand Machines, taken in Exchange for New Tools.

24 in. Swing	22 ft.	Bed	Shafting Lathe,		Providence.
36 " "	12 "	"	Engine	"	Putnam.
33 " "	12 "	"	"	"	Portland Co.
18 " "	8 "	"	"	"	Flather.
18 " "	7 "	"	"	"	David W. Pond.
17 " "	5½ "	"	"	"	Shepard.
15 " "	6 "	"	"	"	Fitchburg.
12 " "	5 "	"	"	"	Prentice.

Putnam Gap Chucking Lathe, 60 in. swing, 9 ft. bed.
Monitor Brass Lathe, 18 in. swing, 5 ft. bed.
Small Planer, planes 16 in. wide, 3 ft. long. G'd order
Providence " " 24 " " 5 " " " "
Hendey " " 26 " " 6 " " " c'dt'n.
Bement " " 30 " " 8 " " " "
Hendey Shaper. 24 in. stroke. Fine condition.
Wiley and Russell Bolt Cutter No. 5, cuts ¾ to 1¼"
Brown & Sharpe Screw Machine No. 5, largest size.
Brainard No. 7 Milling Machine with Vise.
Car Wheel Borer, 48 in. swing. Fine condition.
Brainard Gear Cutter, 30 in. Automatic Feed.
" " " 18 " " "
Garvin No. 2 Gang Drill, 2 spindles.
" " 4 " 4 "
Pratt & Whitney Vertical Tapping Machines.
" 2 in. Cutting-off Machine.

Send for our List of new Tools. We carry much the largest stock in the country.

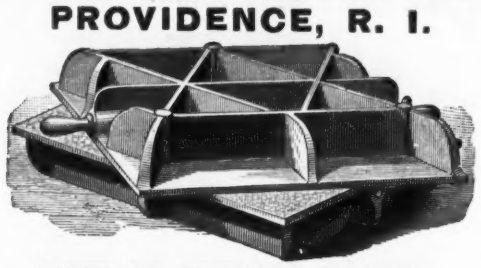
156 Oliver St., - Boston.

BROWN & SHARPE MFG. CO.,

MANUFACTURERS OF

MACHINERY AND TOOLS

PROVIDENCE, R. I.



SIZES OF SURFACE PLATES.

4½ in. x 6 in.	9 in. x 9 in.	12 in. x 12 in.	16 in. x 16 in.
6 in. x 6 in.	9 in. x 14 in.	12 in. x 18 in.	18 in. x 18 in.
6 in. x 12 in.	10 in. x 15 in.	14 in. x 14 in.	18 in. x 36 in.
6½ in. x 18 in.	10 in. x 30 in.	14 in. x 18 in.	24 in. x 24 in.
		36 in. x 66 in.	

Illustrated Catalogue Mailed on Application.

WESTERN AGENT, S. A. SMITH, 23 South Canal Street, Chicago, Ill.

DRIVING WHEEL LATHES.

R. R. AND LOCOMOTIVE SHOP EQUIPMENTS.

NILES TOOL WORKS.

HAMILTON, OHIO.

NEW YORK, 96 Liberty St.
PHILADELPHIA, 705 Arch St.
CHICAGO, 96 Lake St.

CRANES

THE YALE & TOWNE MFG CO.
STAMFORD CONN
NEW YORK CHICAGO PHILA BOSTON

The Original Unvulcanized Packing

CALLED THE STANDARD—As it is the Packing by which all others are compared.

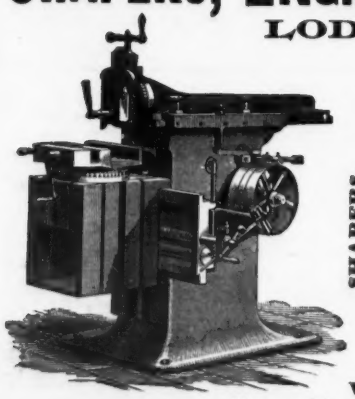
Accept no packing as JENKINS PACKING unless stamped with our "Trade Mark."

JENKINS BROS. { 71 JOHN STREET, N. Y. / 105 MILK STREET, BOSTON. / 13 SOUTH FOURTH ST., PHILA. / 54 DEARBORN STREET, CHIC.\GO.

SHAPERS, ENGINE LATHES & DRILLS.

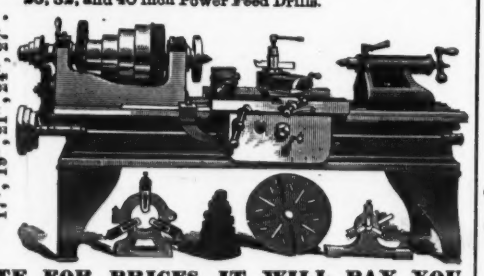
LODGE, DAVIS & CO.,

CINCINNATI, OHIO.



SHAPERS, 8", 10", 15", 20", 26", 32" Stroke.
ENGINE LATHES, 17", 19", 21", 24", 27".

20 inch Upright Drills. 25 inch Back Geared.
24 " and
28, 32, and 40 inch Power Feed Drills.



WRITE FOR PRICES, IT WILL PAY YOU

(See special notice of Engine Lathes on page 15.)

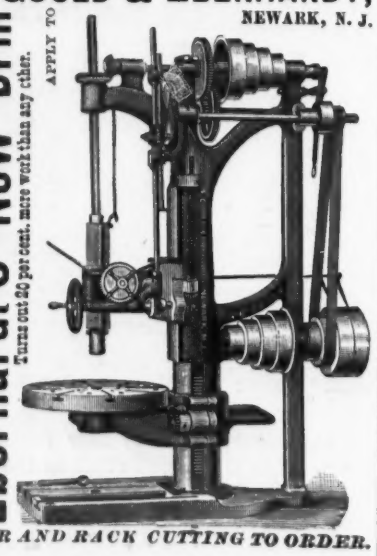
E. GOULD & EBERHARDT,

NEWARK, N. J.

Eberhardt's New Drill

Turns out 20 per cent. more work than any other.

APPLY TO



GEAR AND RACK CUTTING TO ORDER.

SEND FOR NEW

ILLUSTRATED CATALOGUE

—AND—

PRICE LIST

—OF—

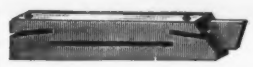
Milling Machines, Drill Presses, Lathes, &c.

READY JUNE 15th, 1888.

E. E. GARVIN & CO.,

139-141-143 CENTRE ST., - N. Y. CITY.

THE PRATT & WHITNEY CO.,



HARTFORD, CONN.,

Have reduced the Selling Prices

—OF—

Machine Screw Taps & Combination Lathe Chucks.

Send Specifications and ask for Terms.

WESTERN BRANCH:
100 W. Washington St., Chicago, Ills.

WARNER & SWASEY,

CLEVELAND, OHIO,

MACHINE TOOLS

For Iron and Brass Work.

SMALL TOOLS & FIXTURES.

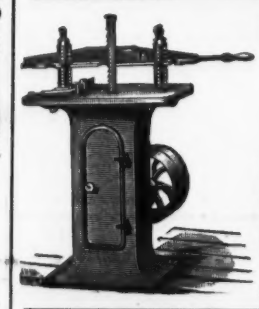
Gear Cutting in all its Branches.

ILLUSTRATED CATALOGUE ON APPLICATION.

GEO. W. FIFIELD,

Manufacturer of ENGINE LATHES from 16 to 48 in. swing. Cuts, Photographs and Prices furnished on application. Lowell, Mass., U. S. A.

Gear Wheels and Gear Cutting.—I make g to order, or cut teeth on g blanks sent to me. Of all kinds. Of all sizes to six ft. dm. Small orders or large ones. Fine g or cheap g. Small cast g. Ready made brass g by mail at low prices. Bevel g with perfect planed teeth. Hand Book on g, $1. Facilities complete. Terms reasonable. Send for cat. GEO. B. GRANT, 66 Beverly St., Boston, Mass.



KEY-SEATING MACHINES,

and 20-in. Drills

A SPECIALTY.

Our Key-Seating Machine will save enough in 60 days' use to pay first cost; no shop can afford to do without one. We have now ready for prompt shipment both Key-Seating Machines and 20-in. Drills. Send for Photo. and Catalogue.

W. P. DAVIS,
NORTH BLOOMFIELD, N. Y.

REMOVAL.

THE POND MACHINE TOOL COMPANY,

Formerly of Worcester, Mass.

The new shops of this company are located at Plainfield, N. J., forty minutes' ride from New York city on the line of the Central Railroad of N. J., and consist of the following:

A machine shop 500' long by 100' wide; a foundry 250' long by 90' wide; also commodious buildings for the storage of sand, coal, coke and pig iron; ample and convenient wash rooms for the men; fire-proof two story pattern storage; blacksmith shop; engine and boiler houses. These buildings are detached from the machine shop and foundry. There is an elevated railroad for the convenient distribution of raw materials, and a railroad running through the machine shop for shipping. The whole plant is supplied with the incandescent system of electric lighting.

The machine shop and foundry have overhead traveling cranes running through their entire lengths; also light traveling cranes, which serve every tool, and a number of jib cranes in the foundry and scratch rooms. The foundry has capacity for making the heaviest class of castings.

All our tools are expressly designed for the economical manufacture of heavy machinery for railroad and general machine shop equipment, from new patterns of the latest and best designs.

SALESROOM and OFFICE, 111 & 113 Liberty St., N. Y. City.

NEW SHOPS, Plainfield, N. J.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.

J. M. ALLEN, PRESIDENT.

W. B. FRANKLIN, VICE-PRESIDENT.

J. B. PIERCE, SECRETARY.

Lathes and Planers

FOR ALL PURPOSES.

THE G. A. GRAY CO.,

477, 479 & 481 Sycamore, cor. Webster, Cincinnati, Ohio.

Photographs and prices sent upon application.

STEEL CASTINGS.

PRATT & LETCHWORTH,
PROPRIETORS
Buffalo Steel Foundry,
BUFFALO, N. Y.

PUNCHING PRESSES, DIES,

And other Tools for the Manufacture of all kinds of

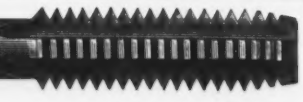
SHEET METAL GOODS, DROP FORGINGS, —ETC.— DROP HAMMERS.

STILES & PARKER PRESS CO.

MIDDLETOWN, CONN.

Branch Office and Factory 203, 205 and 207 CENTRE STREET, NEW YORK.

J.M. CARPENTER
PAWTUCKET, R.I.



Manufacturer —of— TAPS & DIES